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→ The book tells the story of the people who made the laboratory one of the most successful and most respected Arctic research facilities in the world. It probes their successes, failures, frustrations, and disasters, and focuses on the problems that administrators and researchers alike had to face and solve. The research programs and their value are described and assessed in terms of individual achievement and scientific contribution. The stories and recollections of the laboratory's personnel provide a human element that is missing in most historical books.

Up to 1966, a total of 784 research project were carried out with ARL assistance. These projects involved 74 US and Canadian educational institutions, 12 foreign schools, 34 government agencies, and a number of independent institutions and private firms. An estimated 1500 researchers worked on these projects; some 1100 of them are named in the book.

The authors analyze the impact of the laboratory on researchers, institutions, government agencies, and the Navy itself. Readers will find this analysis factual, candid, and absorbing, especially the laboratory's influence on the lives of those who worked there.

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THE ARCTIC INSTITUTE OF NORTH AMERICA



Arctic Laboratory

JOHN C. REED

ANDREAS G. RONHOVDE

**A HISTORY (1947-1966) OF THE NAVAL ARCTIC
RESEARCH LABORATORY AT POINT BARROW, ALASKA**

PREPARED UNDER OFFICE OF NAVAL RESEARCH
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ACRONYMS AND ABBREVIATIONS

AAC	Alaska Air Command
AACS	Army Alaska Communications System
AEC	Atomic Energy Commission
AFB	Air Force Base
AFCRC	Air Force Cambridge Research Center
AFCRL	Air Force Cambridge Research Laboratories
AGB	Icebreaker
AINA	The Arctic Institute of North America
AKA	Attack cargo ship
ARCON	Arctic Contractors, the prime contractor for Pet 4
ARL	Arctic Research Laboratory. In 1967 the ARL officially was redesignated the Naval Arctic Research Laboratory.
ARLAB	Arctic Research Laboratory Advisory Board
ARLIS	Arctic Research Laboratory Ice Station, ordinarily used with a numerical designation
ARPA	Advanced Research Projects Agency, Department of Defense
AST	Alaska standard time
ASW	anti-submarine warfare
BAREX	Barrow Expedition, the annual resupply expedition to Pet 4
BOQ	bachelor officers' quarters
BUAIR	Bureau of Aeronautics
BUDOCKS	Bureau of Yards and Docks

ACRONYMS AND ABBREVIATIONS (cont.)

BUMED	Bureau of Medicine and Surgery
BUORD	Bureau of Ordnance
BUSANDA	Bureau of Supplies and Accounts
BUSHIPS	Bureau of Ships
C 46	a Douglas twin-engine freight aircraft
CAA	Civil Aeronautics Administration
CAPT	Captain
CDR	Commander
CEC	Civil Engineer Corps, USN
C and GS	Coast and Geodetic Survey
CNO	Chief of Naval Operations
CNR	Chief of Naval Research
CO	Commanding Officer
COM 17	17th Naval District
CPO	Chief Petty Officer
CRREL	Cold Regions Research and Engineering Laboratory, U. S. Army
DARL	Director, Arctic Research Laboratory
DC 3	a twin-engine Douglas passenger aircraft, Navy designation is R 4 D
DEW Line	Distant Early Warning Line
DNPR	Director, Naval Petroleum and Oil Shale Reserves
DOD	Department of Defense
DRNL	Defence Research Northern Laboratory

ACRONYMS AND ABBREVIATIONS (cont.)

ELF	extra low frequency
EPI	electronic position indicator
ESSA	Environmental Science Services Administration
ETD	estimated time of departure
FAA	Federal Aviation Administration
FEC	Federal Electric Corporation
GBL	government bill of lading
GMDRL	General Motors Defense Research Laboratory
GS	Geological Survey
HEW	Department of Health, Education, and Welfare
HMCS	Her Majesty's Canadian Ship
HMS	Her Majesty's Ship
HO	Naval Hydrographic Office
ICR	Institute for Cooperative Research
IGY	International Geophysical Year
INQUA	International Association for Quaternary Research
IQSY	International Year of the Quiet Sun
JHU	The Johns Hopkins University
LCDR	Lieutenant Commander
LCM	Landing Craft, Medium
LCOL	Lieutenant Colonel
LST	Landing Ship, Tank

ACRONYMS AND ABBREVIATIONS (cont.)

LT	Lieutenant
LTJG	Lieutenant, Junior Grade
LVT	Landing Vehicle, Tracked
MATS	Military Air Transport Service
MC	Medical Corps, or megacycle
MGEN	Major General
MIT	Massachusetts Institute of Technology
MOQ	Married Officers Quarters
MPH	miles per hour
MSTS	Military Sea Transport Service
NASA	National Aeronautics and Space Administration
NATS	Naval Air Transport Service
NAVOCEANO	Naval Oceanographic Office
NBS	National Bureau of Standards
NCEL	Naval Civil Engineering Laboratory
NEL	Naval Electronics Laboratory
NOL	Naval Ordnance Laboratory
NPR 4	Naval Petroleum Reserve No. 4
NSF	National Science Foundation
NWT	Northwest Territories
OICC	Officer in Charge of Construction, Pet 4
ONPR	Office of Naval Petroleum and Oil Shale Reserves
ONR	Office of Naval Research

ACRONYMS AND ABBREVIATIONS (cont.)

PBY	a large Navy amphibious aircraft
Pet 4	the exploration for oil of NPR 4
PFC	Private, First Class
PHS	Public Health Service
POL	petroleum, oil, lubricants
PS and D	Puget Sound and Drake Construction Company
P2V	a twin-engine Lockheed Navy reconnaissance aircraft
RADM	Rear Admiral
R and D	Research and Development
RCA	Royal Canadian Army
RDB	Research and Development Board, Department of Defense
ROICC	Resident Officer in Charge of Construction
R5D	a Douglas four-engine aircraft
SAC	Strategic Air Command
SDARL	Scientific Director, Arctic Research Laboratory
SIPRE	Snow, Ice, and Permafrost Research Establishment, U.S. Army
SRI	Stanford Research Institute
T-3	An ice island drifting in the Arctic Ocean. It is sometimes called Fletcher's Ice Island, after its discoverer, LTCOL Joseph O. Fletcher, USAF.
UCLA	University of California at Los Angeles
UHF	ultra high frequency

ACRONYMS AND ABBREVIATIONS (cont.)

USAF	United States Air Force
USC	University of Southern California
USCGS	U.S. Coast Guard Ship
USNUSL	U.S. Navy Underwater Sound Laboratory
USS	United States Ship
VADM	Vice Admiral
VHF	very high frequency
VIP	Very Important Person
VLF	very low frequency
Weasel (M 29 C)	a light tracked gasoline-driven vehicle
WECO	Western Electric Company
WHOI	Woods Hole Oceanographic Institution

ARCTIC LABORATORY

by

John C. Reed and

Andreas G. Ronhovde

PREFACE

The United States Navy has been interested and involved in arctic exploration and research for more than a hundred years - ever since President Zachary Taylor acceded to the appeal of Lady Jane Franklin for help in searching for the expedition of her husband, Sir John Franklin, who disappeared into the unknown in 1845. LT Edwin Jesse De Haven commanded the first Navy venture into Baffin Bay, Lancaster Sound, and the Wellington Channel in the eastern Arctic of North America in 1850 and 1851. He was followed in 1853-1855 by the former naval surgeon Elisha Kent Kane who previously had sailed with De Haven. Thus began a proud tradition of deep involvement in the Arctic and the problems and opportunities there that has continued and broadened to the present day.

In 1879 LT George Washington De Long was placed in command of USS Jeannette by Secretary of the Navy R. W. Thompson and embarked on that tragic expedition into the western Arctic that ended on the lonely delta of Siberia's Lena River in 1881. A direct result of that expedition was another Navy effort that resulted in the acquisition of a great deal of information about the part of northern Alaska that is the scene of the events

recorded in this book. The story is summarized well by Brooks:^{1/}

"After the return of the survivors of the . . . Jeannette expedition, . . . , a number of naval officers were sent to northeastern Siberia to recover the bodies and records of those who had lost their lives. By chance, one of them, Lieutenant George M. Stoney, became marooned on Kotzebue Sound . . . in the summer of 1883; he utilized his time in exploring the delta of the Kobuk River, which was then practically unknown. This trip roused Stoney's interest, and he induced the Navy Department to send him back the following year. He made the passage to Hotham Inlet by schooner, ascended the Kobuk River on a steam cutter for some 200 miles, and then by canoe up a tributary to its source. This season's work led to Stoney's being given command of a still more elaborate expedition in 1885 Winter quarters were established on the Kobuk, about 250 miles above its mouth, and the party spent the winter in extensive explorations. Stoney himself explored the headwaters of the Noatak and of the Alatna, . . . as well as the head of the Selawik River, south of the Kobuk. Of Stoney's officers, Ensign Reed led a party from the winter camp to the Noatak River, and Assistant Engineer Zane reached the Yukon by way of the Pah and Koyukuk rivers; but the most noteworthy trip was that made to Point Barrow

^{1/} Brooks, A. H., *Blazing Alaska's Trails*, The University of Alaska and the Arctic Institute of North America, 1953, pp. 277-278.

by Ensign W. L. Howard. Leaving the winter camp in April, with two white men and two natives he proceeded to the northeast across the Noatak to the valley of the Colville, followed this down in company with a party of natives for some 20 miles, and then crossed to the headwaters of the Chipp River. Here he discarded the dog teams he had used up to this point for transporting his supplies, and descended the Chipp River to the coast in native skin boats, arriving at Point Barrow on July 15, the first white man to cross northern Alaska."

Next J. H. Turner of the Coast and Geodetic Survey established a position station on the Porcupine River at the Alaska-Yukon boundary and in a phenomenal winter dog-team trip generally defined the 141st meridian northward to the arctic coast. In 1901 the Geological Survey sent its first reconnaissance party into northern Alaska. F. C. Schrader and W. J. Peters ascended the John River, traversed the Anaktuvuk Pass, and descended the Anaktuvuk and then the Colville River to the coast. From that journey came the first basic knowledge of the geology of the region. In 1917 the petroleum seepages near Cape Simpson were "discovered" by Alexander Malcolm Smith, although they long had been known by the native Eskimos. In 1923 President Harding by Executive Order established Naval Petroleum Reserve No. 4 in northern Alaska. The new reserve covered about half of the foothills and coastal plain of that great region and aggregated about 35,000 square miles. Thus the Navy's interest was made clear-cut and specific.

At the Navy Department's request and expense the Geological Survey carried out exploratory geologic studies in NPR4 for four years, 1923 through 1926, and the broad outlines of the geology and the topography were worked out. From 1926 to the start of World War II there was little interest in northern Alaska. There was an abundance of petroleum products and NPR4 was far too isolated to be of any real concern. But with the war the situation changed and the possibility of Alaska contributing petroleum for the now voracious demands began to be considered seriously. The history of NPR4 ^{2/} states:

"The whole pattern was such that there was need for a more complete knowledge of the petroleum potentialities of Naval Petroleum Reserve No. 4. Speculation about the Reserve and its possible petroleum resources took account of several possibilities - if the area contained large oil reserves, perhaps it would be possible to pipe the crude oil to the Pacific coast for shipment outside Alaska; maybe it should be refined in northern Alaska; possibly it could be used for Alaskan needs only, thereby saving the cost of transporting petroleum to Alaska; refining in the Reserve might provide products to supply bases in the Arctic; perhaps the oil would be refined in central Alaska or on the Pacific coast of Alaska and distributed from there."

^{2/} Reed, J. C., Exploration of Naval Petroleum Reserve No. 4, Part 1, History of the Exploration, U. S. Geological Survey, Professional Paper 301, 1958, p. 3.

And so the decision was made to initiate in 1944 a major oil exploration program (Pet 4) in northern Alaska. The Navy's interest thus became real and urgent indeed. The NPR4 history ^{3/} points out that: "Through planning, patience, rugged determination, Pet 4 proved that the rigors of the Alaskan Arctic can be met and subdued at any season for indefinite periods by substantial numbers of men who, at the same time, can effectively carry on complex and difficult technical operations. . . The fact that an extensive program was going on and the presence of the facilities that were established to carry it on made many other activities possible in that region that otherwise would have been prohibitively expensive."

The last quoted sentence applies directly to the establishment and the early years of operation of the Arctic Research Laboratory (ARL). Without Pet 4 it probably would not have been established and a bright page in the record of the Navy's interest and participation in arctic affairs would not have been written. The Army also has been involved in northern matters for many years but generally in different ways. So too the Air Force in later years through the DEW Line and in other ways has had its part to play. And Alaska, being an American Territory and later the 49th State, has felt the impact of the work of many Federal civilian agencies - of which the Geological Survey and the Coast and

^{3/}Ibid., p. 2.

Geodetic Survey are outstanding examples, but by no means the only ones.

The Navy has not confined its interest and involvement in polar affairs to the Arctic - although the Arctic is the area of concern of this report. The Navy has long been closely associated with antarctic projects as well and still is. In fact the first naval participation in antarctic matters goes back even farther than in the Arctic. In 1838 LT Charles Wilkes commanded a Navy expedition to the Antarctic and recognized that region as a continent. Every schoolboy is familiar with the name of RADM Richard E. Byrd and at least some of his antarctic attainments. And during the International Geophysical Year and thereafter it was the Navy that provided the basic logistics support through the Antarctic Support Force under a series of distinguished naval officers.

The ARL was one of the very early projects of the Office of Naval Research. The establishment of ONR was summarized well by the late Alan T. Waterman.^{4/} He said,

"The foundation was laid for the ONR in June, 1945, by the establishment of the Office of Research and Inventions under Executive Order of the Secretary of the Navy. In it were gathered together the major components of what was to be the ONR under the leadership of Vice Admiral Harold Bowen . . .

^{4/}Waterman, Alan T., *Pioneering in Federal Support of Basic Research. From Research in the Service of National Purpose*, U. S. Government Printing Office, 1966, p. 4.

"The Act establishing the Office of Naval Research as a statutory agency was engineered with the cooperation of a discerning Congress, by a distinguished and brilliant group of personalities, notably James R. Forrestal, Secretary of the Navy, Struve Hensel, General Counsel, John T. Conner, his special assistant . . . , and Admiral Lewis Strauss, a member of his staff."

Dr. Harvey Brooks in a presentation to the Vicennial Convocation of ONR in May 1966 listed a number of examples of "the right science at the right time even though few foresaw the usefulness and relevance when ONR first began to sponsor it." One of these was "The early launching of an arctic research program, data from which suddenly proved vital when it became necessary to install the DEW line." He referred of course to the ARL and he could have listed other examples pertaining to the ARL with equal appropriateness.

The outstanding cumulative accomplishment of the ARL is the pushing back of the frontiers of knowledge in many scientific disciplines of the arctic regions through ARL projects over the years. The ARL also has been of assistance, some not in the scientific field, to the United States. It has helped to make the Arctic Ocean an accepted operational field for nuclear submarines. It has assisted in the development of better ways of living, working and moving in the Arctic on land, sea, and in the air. It established and supported floating stations on ice islands and maintained them for long periods as they drifted over the Arctic Ocean.

Altogether the record of the ARL from its inception is a remarkable story of scientific effort and accomplishment for the Navy and for the United States. An attempt is made to tell the story in this volume. The story is told through 1966, although in somewhat less detail from late 1964 on. Administration and research have been treated together up through the administration of Dr. MacGinitie. Thereafter administration and research are discussed separately. In approaching the preparation of the story, the authors have tried to appraise in a general way the varied interests and needs of potential readers.

The organization and administration of the Laboratory are described. Some of the problems that arose and how they were solved or avoided are discussed. The tie lines back to the ONR in Washington are identified and reviewed. And especially some of the many, many internal and external relationships with other government and civilian agencies are traced and their effects noted. Also included are examples of some of the special relationships with the indigenous native people (the Eskimos); with the scientists themselves, many of them previously completely unfamiliar with the Arctic and some of the restrictions and limitations of working in those environments; and with the variety of representatives of other groups.

The book also deals specifically with the research program itself. The development, continuity and emphasis of the program are discussed, including the parts that were planned and guided as well as the parts that

developed through the initiative of the researchers. The book explores the consistent broad policy of an open door to any acceptable projects of others who wished to work there. The size and breadth of the program - in the winter lows and the summer highs - are considered, along with the wide range of disciplines involved and the balance, and sometimes the limitations of the balance among them.

Finally, an analysis is made of what the whole effort is felt to have been worth. It tries to appraise the relationship of the program at the ARL to U.S. research in general. The interpretation is based on several sources, including the study of about three hundred completed questionnaires returned by researchers, discussions with most of the ARL directors and some of the scientists, a review of many of the publications and especially the publication record, and the considered judgment of the authors.

In a nutshell - we feel that the ONR and the Navy should be proud indeed of the ARL and its record; we feel that the ARL is well worth continued and expanded support; and we feel that the record fully justifies the setting down of the story.

Regretfully, we must warn the reader that the lack of time has prevented a final editing of the manuscript. However, we feel that the story here told should now be made available to the public despite some roughness in the text.

THE BACKGROUND

This is the Way it Started

It was the 6th of August 1947 - a heavily laden C46 aircraft lumbered over the pierced-metal surface laid on the coarse beach sand and rolled to a stop. Out from the load of freight climbed seven men led by Professor Laurence Irving of Swarthmore College. The sun was still high, for the days were long, it being only about six weeks past the 21st of June, and even at midnight the sun was just beginning to touch the northern horizon. For a change the sky was clear, the wind calm, and the sea was free of ice as far as the eye could see. The dull greenish brown tundra, relieved by its myriad lakes, large and small, stretched southward seemingly without limit toward the Brooks Range over which the aircraft had come. Thus the Arctic welcomed to Point Barrow, Alaska, the first group of scientists that formed the nucleus of what was to become the Arctic Research Laboratory (ARL) of the Office of Naval Research (ONR).

It was an historic occasion, although the little group sweltering in unfamiliar Navy-issued cold-weather clothing did not realize it as they gazed around at the strange environment. The temperature was in the 50's and all around was the noise and bustle of an oil-exploration camp. Caterpillar tractors churned the soft sand as they hauled equipment to storage areas. Weasels (M29C), those small tracked vehicles so useful in the Arctic, seemed to be scooting in all directions on a variety of missions. The landscape was dotted with 56-gallon fuel drums, that

ubiquitous trade mark of the American developer in out-of-the-way places all over the world. At the beach lay power barges ready for their mission of lightering freight ashore.

Not much attention was being paid to the small group of scientists for this was the main supply camp of the Navy's exploration for oil in Naval Petroleum Reserve No. 4 - an operation that in 1947, after three years of intense activity was in full swing and was known as Pet 4. The annual ship expedition (Barex) - that year including four AKA's, an LST, and the ice-breaker (AGB) USS Burton Island - was due and first attention was being given to preparations for unloading the ships and hastening them south before the polar ice pack again moved in to the shore.

Thus without much special notice was launched the Arctic Research Laboratory. That laboratory for a generation has been a major center of U.S. arctic research. It is the only U.S. laboratory devoted to full-time support of basic research in the Arctic.^{5/} From it has come a steady flow of arctic environmental knowledge that repeatedly has stood this nation in good stead. Britton^{6/} also points out that "One distinguished Canadian has expressed the view that results from the research of a single

^{5/} Britton, Max, ONR Arctic Research Laboratory, BioScience, vol. 14, No. 5, 1964, p. 44.

^{6/} Britton, Max, Introduction to Special Issue on Arctic Biology, BioScience, vol. 14, No. 5, 1964, p. 12.

permafrost program at the Arctic Research Laboratory enabled savings in the cost of construction of the Distant Early Warning Line greater than all money spent on ARL in its entire history."

This book is the story of the ARL - an outstandingly successful basic research facility in an inhospitable and uncompromising environment. The ARL has yielded a surprising amount of new arctic information at very low cost. The history of the ARL spans several milestones in ONR and in U.S. research in general. Its history is closely related to some of those milestones. It strongly influenced some of them and was influenced by them.

The stage on which has been enacted the story of the ARL is huge. Center stage is the laboratory itself, virtually at Point Barrow, Alaska, at about $71^{\circ} 20' N.$ and $156^{\circ} 46' W.$ Landward the stage includes all the Brooks Range stretching from Cape Lisburne and Point Hope, that project into the Chukchi Sea, eastward to the Mackenzie River of Canada's Northwest Territories; the northern foothills of Alaska; the limitless, flat, coastal plain of the so-called "Arctic slope;" and even Banks and other islands of the arctic archipelago of the Northwest Territories.

Seaward are the Beaufort and Chukchi Seas and the whole Arctic Ocean. Action has gone on from far west of the international date line eastward to a point almost on the Arctic Circle between Iceland and Greenland. Projects have been carried on northward to the North Pole.

The Office of Naval Research was new - only about one and a half years old - when the Arctic Research Laboratory came into being under its sponsorship. Furthermore the Navy's Office of Research and Inventions, from which ONR developed, had become an entity only in 1945. Thus the ARL and the policies that were developed to guide it were important and influential in regard to ONR itself. The ARL also is only about two years younger than The Arctic Institute of North America. The AINA from the start of the ARL has been closely associated with it to the mutual benefit of both organizations. When queried by the ONR regarding the advisability of establishing a research laboratory in the Arctic, Dr. A. L. Washburn, Executive Director of the Arctic Institute replied - "An arctic laboratory for the pursuit of basic scientific research is one of the best ways to facilitate the acquirement of new information. It affords a base of operations for scientists, encourages cooperative observations in different fields of science, and is the only means of effecting some types of research requiring frequent observations at fixed points over a period of years . . . The Arctic Institute is keenly interested in all fields of endeavor outlined in your letter and will be glad to cooperate in every way it can."

The National Science Foundation, after several false starts, came into being by Act of Congress in 1950. At that time both the ONR and the ARL were active, productive organizations. The ARL was supporting a variety of arctic research projects of scientists from a substantial number of colleges and universities. There has been much speculation about the

apparent lack of specific interest in arctic research within the growing NSF. During the early 1960's the NSF developed a large, balanced, integrated antarctic research program but nothing comparable was evolved in the Arctic. Possibly, the speculation runs, it was felt that the Arctic was sufficiently provided for by the ONR through the ARL.

With the International Geophysical Year (IGY) (1957-58), that for the most part was supported financially by the NSF, came a small arctic program. Projects under that program that came within logistics-support reach of the ARL were assisted whenever possible by the ARL.

Following the end of World War II the University of Alaska embarked on an accelerating course of growth and expansion in many ways. That trend continues. The ARL became specifically associated with the University in 1954 when, under E. N. Patty, the University's third president, a contract was entered into between the ONR and the University whereby the University became the operator of the ARL and provided the Director and staff.

U. S. interest in ice islands, those large and ghostly wanderers of the Arctic Ocean, county-sized blocks broken from the ice shelf bordering a part of Ellesmere Island, began with the discovery and occupancy of Ice Island T-3 (Fletcher's Ice Island) by the Air Force in 1952. Soon, however, continuing U. S. programs on ice islands and occasionally on sea ice were initiated by the NAVY through the ARL. These programs have continued and still go on - some still on the remaining part of T-3. A colorful chapter

in the story of ice-island occupancy was the discovery, use, and dramatic abandonment of ice island ARLIS II between May 1961 and May 1965. Ice-island programs were spurred, of course, by the demonstration in about the same interval of the practicability of the use of the Arctic Ocean by nuclear-powered submarines. Further interest was occasioned in 1954 by the east to west transit of the Northwest Passage by the Canadian icebreaker HMCS Labrador under Captain (now Commodore, ret.) O. C. S. Robertson.

The ARL supplied much information and advice during the planning, construction, and operation of the Distant Early Warning Line (DEW Line). The environmental information available through the ARL was in great demand in that operation. The DEW Line operators and the ARL still share the same camp at Barrow - the old Pet 4 main field base.

The establishment and early operation of the ARL were made possible by the oil exploration of Naval Petroleum Reserve No. 4 and adjacent areas^{7/} (Pet 4) from 1944 through 1953. The encouragement and cooperation of the Office of Naval Petroleum and Oil Shale Reserves and of the Bureau of Yards and Docks were unflagging. The help provided was based on the deep-seated conviction of the value of the research effort. Many times support was given at substantial sacrifice and inconvenience to the oil-exploration effort. That confidence in the value of the research program was well placed.

^{7/}Reed, J. C., op. cit.

The Navy's Long Interest in Northern Alaska

Naval interest in the Arctic and specifically in arctic Alaska is not new. It goes far back in the history of the U.S. Navy. Perhaps this is because the Arctic generally was reached by ship up until the era of modern aircraft. Much of the exploration of the arctic slope of Alaska - the backyard of the ARL - was by officers of the U.S. Navy and by explorers supported by the Navy. Still earlier, the ships and men of the British Navy outlined the coastal geography and described the environments.

In 1778 CAPT James Cook passed through the Bering Strait and proceeded along the coast of North America as far as Icy Cape. F. W. Beechey, commanding HMS Blossom and under orders to cooperate with Sir John Franklin who was working westward along the coast from the mouth of the Mackenzie River, in 1826 pushed northeastward until further progress was blocked by ice near Franklin Point. From there two of CAPT Beechey's men - his mate Elson and Smyth - followed in a small boat the more open water along shore as far as Point Barrow, later the site of the ARL. Franklin had worked his way westward to the Colville River only about 150 miles from Elson and Smyth at Point Barrow.

Eleven years later P. W. Dease and Thomas Simpson of the Hudson's Bay Company went down the Mackenzie and in a small boat followed the coast westward to the vicinity of Cape Simpson. From there Simpson and a small group completed the traverse of the north coast to Point Barrow on foot. In the interval 1848 to 1853 much was learned of northwestern North America through the various relief expeditions sent out in search of Sir John Franklin.

LT P. H. Ray, U.S. Army went to Point Barrow in 1881, 14 years after the purchase of Alaska from Russia, and carried on scientific observations for two years. This was an expedition of the First Polar Year which was the forerunner of the Second Polar Year in 1932 and of the IGY. LT Ray made extensive magnetic and meteorological observations and explored the land area around Point Barrow for about 100 miles.

LT George M. Stoney, USN, in 1883 began explorations in northwestern Alaska that continued for several years (see pp. ii-iii). According to Brooks,^{8/} "The results of the expedition were a fairly accurate survey of the Kobuk valley and sketch maps of the Selawik, upper Colville, upper Noatak, and Alatna rivers. Stoney was the first to make instrumental surveys in the interior of Alaska. It is very unfortunate that his full report and maps were never published. The manuscript maps are still on file in the Navy Department, and the only record of this elaborate expedition is a brief statement of results prepared many years later."

Only brief mention is made of early explorations far to the east of Point Barrow in the far eastern part of the sphere of activity of the ARL. That is the area near the boundary between Alaska and the Yukon Territory at the 141st meridian, near the east end of the Brooks Range. J. D. McConnell of the Geological Survey of Canada studied the valley of the upper

^{8/} Brooks, A. H., op. cit., p. 278.

part of the Porcupine River in 1889. The next year the Canadian surveyor William Ogilvie explored from the Yukon to the head of the Porcupine. Also in the winter of 1890 J. H. Turner of the U. S. Coast and Geodetic Survey travelled by dog team from the Porcupine to the arctic coast, generally near the international boundary. Other explorations were made in that area later by Frederick Funston, who was collecting plants for the Department of Agriculture and who went to Herschel Island from the Porcupine in the winter of 1894, and by A. G. Maddren and William Osgood for the Smithsonian Institution in 1904. It was not until 1912 that Thomas Riggs, Jr. of the International Boundary Commission and his Canadian counterpart J. D. Craig set the northernmost Alaska-Canada boundary post on the shore of the Arctic Ocean. Riggs later became a Governor of Alaska.

Of special interest was an exploratory trip in 1901 by W. J. Peters and F. C. Schrader of the Geological Survey. They travelled overland across central Alaska in the winter and reached the Koyukuk at the mouth of the John River, near the present village of Bettles. After the breakup, they ascended the John River in canoes, dragged them through the Anaktuvuk Pass and then traversed the Anaktuvuk to the Colville and the Colville to the coast. Thence they proceeded westward in the shallow coastal waters to Point Barrow and on southwestward to Cape Lisburne. From there they obtained passage southward on a vessel that took them

to Nome. Brooks^{9/} has said - "Theirs was probably the most notable exploration which has been made by the Geological Survey."

In addition E. de K. Leffingwell made valuable studies in northern Alaska generally east of the Colville River in the interval 1906 to 1914.

V. Stefansson also explored in northern Alaska between 1908 and 1918.

Then came 1923. President Warren G. Harding was soon to travel to Alaska on his last journey to drive the golden spike at Nenana that signified the completion of the Alaska Railroad to Fairbanks. In February he issued an Executive Order establishing Naval Petroleum Reserve No. 4. The establishment of NPR4 resulted in the Navy Department retaining the Geological Survey to examine the area and report its findings. Investigations went on for four years and the general geography and geology of northern Alaska became reasonably well known.^{10/} Three parties, each with a geologist and a topographic engineer, explored parts of NPR4 in 1923; three parties also operated in 1924, one party in 1925, and one party in 1926. As an example of the sort of expeditions these were, the following is quoted from the history of the exploration of Naval Petroleum Reserve No. 4.^{11/}

"Only one party was sent to the area in 1925. It was led by topographer

^{9/} Brooks, A. H., The Geography and Geology of Alaska, U.S. Geological Survey, Professional Paper 45, 1906, p. 129.

^{10/} Smith, P. S., and Mertie, J. B., Jr., Geology and Mineral Resources of Northern Alaska, U.S. Geological Survey, Bulletin 815, 1930.

^{11/} Reed, J. C., op. cit., p. 20.

FitzGerald and the geologist was W. R. Smith: This party started in the winter by dog team from Nenana and sledged 725 miles to Kotzebue. Thence they proceeded to and up the Noatak River to the Kugururok, starting surveys on the Noatak. From the head of the Kugururok, a pass was found across the Brooks Range into the Utukok, and from a point on that stream another pass was used to reach the upper Colville valley. When the ice broke on the Colville on 30 May, the party changed to canoes and surveyed downstream to the Etivluk, up which they proceeded to the lake at the head. From there they portaged across the Brooks Range divide into the Aniuk and went downstream to the Noatak and on back to Kotzebue, which was reached on 22 August. About 6,500 square miles of hitherto unknown country was mapped, and much was learned of the general geology."

From 1926 on little attention was paid to northern Alaska until the United States was embroiled in World War II. In January 1943 Secretary of the Interior Harold L. Ickes issued Public Land Order 82 that withdrew from entry, subject to preexisting rights, for use in the prosecution of the war all the likely petroliferous parts of Alaska, including all of Alaska north of the drainage divide of the Brooks Range. In March of that year LT W. T. Foran, who had been one of the geologists in northern Alaska in the 1920's, wrote the Bureau of the Budget and pointed out why NPR4 should be explored further for oil.

Late in the summer of 1943 the Bureau of Mines sent a party into northern Alaska by bush plane to look at some of the petroleum possibilities. From those events Pet 4 developed. Pet 4 started in March of 1944 and a good deal had been learned about the geology, geography, and operating conditions by the time Dr. Irving and the rest of his little group landed on the Barrow airstrip in August of 1947.

The Environments of Northern Alaska and the Arctic Ocean

Before embarking on the story of the ARL, some of the environments of northern Alaska and of the Arctic Ocean are described as a background for visualizing the regions that constitute the stage that is the setting of the ARL. Here are summarized the terrain, drainage, relief, climates, and such special features as sea ice and permafrost. Brief attention also is given to the indigenous people, animals, plants, and traversibility.

Point Barrow forms the northern tip of Alaska and is the northernmost point of U.S. territory. Northward and to the east, west, and even southwest is the polar ocean with its distinctive shore features of bars, sand spits, and lagoons, and, farther out, the churning, shifting, ever-restless ice cover. In all other directions stretches the seemingly limitless tundra of the arctic coastal plain - gray, gray-green or white with a thin snow cover, thickly sprinkled with lakes, and crossed by sluggish aimless streams. Far to the south, about 90 miles from Point Barrow, the monotonous coastal plain gives way to the arctic foothills of rolling

tundra uplands and mesas between more sharply etched drainage courses. Still farther south and abruptly bounded by the foothills on the north sweeps the great Brooks Range all the way across northern Alaska.

Thus ocean, coastal plain, foothills, and mountains form the first ring of surface types around the center marked by the ARL. Each of those types is briefly described below. More distant areas, some of which also have been probed by ARL projects, are omitted from specific description except as brief reference is made in discussing some of those projects. It may help the reader's visualization of the land areas that form the backyard of the ARL if from time to time he compares in his mind the Alaskan Arctic with the region stretching eastward from the Rocky Mountains of Colorado to the Mississippi valley. There are many similarities. The Rocky Mountains equate with the Brooks Range and the Rocky Mountain Front, as near Denver, with the steep north front of the Brooks Range. The foothills provinces are comparable and the gentle valley of the Mississippi has its counterpart in the coastal plain.

The monotonous coastal plain

The extensive arctic coastal plain has very little local relief. From the arctic coast near Barrow to its southern boundary the plain rises to an altitude of about 500 feet. At its western end the southern limit of the plain ends at the Arctic Ocean near Cape Beaufort. The boundary thence extends eastward in a somewhat irregular line to a little east of the Canning

River where the plain is less than 20 miles wide. On eastward to and beyond the Canadian border the plain is much narrower than farther west. Smith and Mertie^{12/} describe it well. "Perhaps the most striking characteristic of the coastal plain is the uniformity and monotony of its landscapes. Except for minute minor details, its appearance is everywhere the same. Its slope is so slight that to the unaided eye it appears to stretch away to the horizon as an endless flat. Prominent landmarks are entirely absent. Owing to its featurelessness even minor elevations such as sand dunes 10 feet high appear to be notable prominences . . ."

Across the plain, soggy in the summer, the streams wander sluggishly in contorted, complex channels through and among the thousands of lakes. The Colville is the only large river and it drains a large part of the Brooks Range. Some of the other rivers, like the Sagavanirktok, head in the Brooks Range. Others rise in the foothills. And a few, such as the Oumalik River, head on the coastal plain itself. Some of the streams, especially the larger ones, have built substantial deltas into the Arctic Ocean. In places along the streams are low bluffs, a few perhaps as much as ten or even twenty feet high.

And everywhere are the lakes, thousands upon thousands of them, from tiny ponds to water bodies many miles across. They are especially

^{12/}Smith, P. S., and Mertie, J. B., Jr., op. cit., p. 48.

abundant west of the Colville River. Over some large areas the lakes are generally elongate and lie with their long directions parallel and oriented about 12 degrees west of North. These are the famous oriented lakes of northern Alaska. The largest is Teshekpuk Lake some 80 miles southeast of Barrow. It is more than 25 miles across. Over wide areas the lakes are so numerous that the surface area is much more water than land.

The arctic foothills

The foothills belt of country between the coastal plain to the north and the Brooks Range to the south is about 20 miles wide near the Canadian border and nearly 80 miles in the vicinity of the Colville River. The northern border is not well marked in many places and merges into the coastal plain. The southern boundary against the Brooks Range is scarp-like and distinctive. The general level of the foothills ranges from about 500 feet at the northern edge to around 4,000 feet adjacent to the Brooks Range. The local relief in the northern part of the foothills is seldom more than 1,000 feet but is noticeably greater farther south. Between the streams the surface is broad and rolling. The general strike of the underlying rocks is East. Erosion has etched out the underlying structures and large anticlines and synclines are readily recognized in many places from the air or on aerial photographs.

The streams are incised a few hundred to a thousand or more feet below the uplands. In the southern part of the foothills the major streams flowing northward from the mountains cross in bouldery rapids one or more moraines left by Pleistocene glaciers a short distance in front of the

the mountains. The major streams for the most part continue northward onto the coastal plain and hence transect the structure almost at right angles. The smaller tributaries in contrast are generally along the structure. Most of the valleys are broad and flat except where the main streams flow in canyons across the harder ridges. The streams are braided with large and rapid fluctuations of flow.

The rugged Brooks Range

The Brooks Range, the northwestern equivalent of the Rocky Mountains, forms an imposing barrier across northern Alaska and separates the Alaskan Arctic from the better known interior of Alaska to the south. The range is not especially high - summit altitudes in the western part of the range are in the order of 3,000 feet. Eastward the range is higher - summits are around 6,000 feet in the central part in the region of the Anaktuvuk Pass and near 10,000 feet farther east near the Canadian border.

The Brooks Range is rugged and colorful except in its far western parts where the surface is more rolling. Smith and Mertie point out^{13/} that "Scenically the Brooks Range is extremely attractive because of its sculpture, which has produced ragged mountain masses interrupted by steeply trenched or glacially opened-out valleys . . ." The rugged topography

^{13/} Smith, P. S., and Mertie, J. B., Jr., op. cit., p. 34.

seems accentuated because vegetation is sparse or, over large areas, entirely absent.

The valleys are deeply incised and the major drainage is across the geologic structure. Valley sides are rough and steep. The major streams debouch abruptly from the mountains across the steep north face into the arctic foothills. The Range was widely glaciated in the Pleistocene but the ice never extended far beyond the limits of the mountains because accumulations of snow were limited because of sparse precipitation, a situation that continues today.

The glaciated valleys have the typical U-shape that reflect their origin but the unglaciated ones are narrow and steep. The Brooks Range is crossed by several low passes from its central part westward and those passes are now broad glacial trenches. The present glaciers in the Brooks Range are few and small. They are more numerous and larger in the higher parts of the range toward the east. Glacial and glaciofluvial deposits are abundant and conspicuous in the glaciated valleys within the Range. They impede the drainage so that many lakes have been formed. Pleistocene moraines also extend in blunt lobes into the foothills province from some of the larger valleys of the range but not far.

The ground is permanently frozen

The ARL and its surrounding regions are well within the zone of permafrost (permanently frozen ground) that generally exists where the

mean annual temperature is less than 32° F. Permafrost by definition exists when the ground temperature is perennially below the freezing point of water. Thus permafrost may be present without ice if no moisture is present or if any moisture has a sufficiently high salt content so as not to freeze even below 32° F.

The depth of permafrost in northern Alaska is in places as much as 1,300 feet, perhaps even more. The frozen surface melts in the long days of the arctic summer to a depth of a few inches and the surface layers then are generally wet and soggy because the moisture cannot sink into the ground through the frozen layers below and continued melting produces more and more moisture. Permafrost of course has been extensively investigated at the ARL.

The existence of permafrost is an important and ever-present factor in man's activities in the Arctic. Its understanding is imperative in any substantial development. Only a few examples of the implications of permafrost are mentioned to illustrate the importance of the phenomenon, which is why it is mentioned in this section on arctic environments.

The saturated tundra is crossed with difficulty in the summer even on foot. It is impossible for most ground vehicles. Some tracked vehicles can operate with care but not easily. Most activity on the surface merely lets in more heat that melts more ice and makes the problem worse. Except in a few special situations there is no ground water, and hence no

ground water supplies, within the permafrost zone. Water is usually obtained easily in summer but, in winter, must come from below the ice covering of deeper water bodies. Fresh water bodies less than about nine feet deep freeze to the bottom. Also, water transported any distance in winter must be heated to keep it from freezing. Sewage disposal presents many problems. Installation and maintenance of sewers are difficult and costly. The pipes will freeze unless heated. If heated it is difficult to maintain grade because the ground supporting the pipes melts.

The construction of foundations for structures is most difficult. Buildings may be supported by piles set in the permafrost, provided heat from the buildings is prevented from melting out the piles. Road grades must usually be built up rather than dug in. The latter only exposes more permafrost to melting.

The Mediterranean of the North

At the site of the ARL, Point Barrow projects far into the Arctic Ocean and roughly indicates the division between the Beaufort Sea north of North America and the Chukchi Sea north of the Bering Strait and between North America and Asia. The polar ocean as a whole is a true Mediterranean around which cluster the continents of North America, including Greenland, Asia, and, less tightly, northern Europe. A feature unparalleled in any other comparable water body, except for some partial analogies in the Antarctic, is the shifting, moving, grinding arctic ice

pack that covers all of the ocean in the winter and most of it during the summer. Only a few oversimplified comments will be made about the Arctic Ocean here. A great deal has been learned about the Arctic Ocean in the past twenty or so years, much of it by the Russians, but a substantial amount also by other nations especially Canada and the United States. A large participant in the effort has been the ARL. Research with which the ARL has been identified, and much of it has been exclusively supported by the ARL, has gone on from surface traverses over the ice, small boats operating near shore, ice breakers of both the Coast Guard and the Navy, submarines, small aircraft, and from long-time and transient camps on ice floes and ice islands. Some of the projects will be mentioned later in this account of the ARL and its accomplishments.

Generally the water is shoal for long distances off the coast of northern Alaska. Along the northern Alaska coast, the sea is nearly tideless but considerable differences in water level, up to perhaps a couple of feet or more, are caused by winds from different directions.

According to Reed,^{14/}

"Mostly, the direction of ocean currents along the coast southwest of Barrow is northward, but the details are not yet known. This fact is of great importance to navigators because the currents control the movements

^{14/} Reed, J. C., op. cit., p. 11.

of floating sea ice. It is often unsafe for ships to follow leads opening northward because of the ever present danger of the ice closing in behind, thus blocking escape. On occasion these currents are extraordinarily swift, sometimes several knots, and large floes and ice packs may change position rapidly." Furthermore the directions of the currents may change rapidly, or even reverse.

The arctic sea in the vicinity of the ARL is open for navigation for only a few weeks late in the summer. The length of time that the sea is open for shipping ranges widely from year to year and occasionally the ocean does not open at all. The main ice pack is never far offshore. Although it may be out of sight from the shore for weeks there is the ever-present danger of its moving in without warning and surprisingly rapidly.

After the breakup of the ocean ice in the summer, the sea can no longer be used for over-ice travel by surface vehicles such as weasels or dog sleds. Also in the fall when the sea is freezing again, the ice is too thin for over-ice travel but solid enough to prevent the use of small craft. Usually the sea opens from the south toward the north and closes from the north toward the south.

In addition to the sea ice on the Arctic Ocean are a few larger, thicker masses of ice called ice islands. Their number is not known but they are of significance to man in his use of the Arctic Ocean. They are large blocks, some up to several miles across and possibly 100 feet thick,

that have been broken from the Ward Hunt Ice Shelf that borders a part of the northern coast of Ellesmere Island of northern Canada. They persist for years in the ocean and may make several orbits in a broad clockwise circle from their origin across the top of North America, and on westward and northward to the vicinity of the North Pole and thence south and east again around Canada's north coast. Occasionally an ice island drifts down the east coast of Greenland and out of the Arctic. Some like T-3 and ARLIS II have been the sites of U.S. research stations for years.

Some of the shore features of the Arctic Ocean along Alaska's north coast are interesting and of importance to man's activities. In many places the land passes gently beneath the tideless sea with scarcely a break in the profile. At other places the sea is bordered by low bluffs up to as much as twenty-five feet or even fifty feet high. Offshore are many long, low, narrow bars and islands. Some of these are many miles long. Also long spits and shoals have been built out from the headlands, in some instances extending from headland to headland. These offshore barriers enclose a system of shallow lagoons and bays that are protected from the grinding, shoving action of the sea ice and, when the sea is open, from the rougher open water. These inshore waterways open in the spring long before the ocean itself and allow relatively safe water travel by small craft for a longer time than the open ocean. Furthermore, because the ice is smoother in winter, they are favored routes for alongshore travel by over-ice means up to and including large tractor trains.

The coast also is deeply indented by large estuaries. An example is Dease Inlet and Admiralty Bay east of Point Barrow and the mouth of the Kuk River to the southwest. The latter is nearly closed at the entrance but inside is about thirty miles long.

Much has been learned of the Arctic Ocean through projects of the ARL and others. Much more remains to be learned about the currents, temperatures, and salinities of the ocean; the heat budget and the formation and history of the ice; the depths and the nature of the bottom; the acoustic properties; the nature of the shore and shore processes; and the biologic productivity.

The climate is important

At any place the three principal factors that constitute the climate are temperature, precipitation, and wind. In the Arctic a fourth factor should be added - light. The climate at the ARL is cold, windy, and generally inhospitable. Nevertheless work can be carried on outside by healthy, well-fed men all through the year, except for occasional periods of severe storms. A limiting factor is more likely to be the effect of severe cold on equipment rather than on men. Light must be considered also. In the vicinity of Barrow there is no direct sunlight from late November until late January. However there is a good deal of reflected light at times - the surface is white with snow, and there is starlight, and moonlight intermittently, except during cloudy weather.

In the vicinity of the ARL it is common for the temperature to range widely over the year through. Occasionally the range is as much as 130° - that is from about 65° F. below zero to about 65° F. above zero. Temperatures below zero F. can be expected from October through May and below freezing temperatures are common for short periods even during the summer. Temperatures over the ocean and near the coast are modified somewhat by the marine environment. Away from the coast inland the temperature extremes are believed to be both higher and lower than along the shore.

Northern Alaska is arid. Precipitation near Barrow is less than five inches a year. Most of the precipitation falls as snow. It rains in the short summer period but even then light snow is common. Smith and Mertie^{15/} were much impressed by the wetness of the arctic "desert". They describe the unusual situation as follows: "Although the foregoing instrumental observations constitute the most authoritative and reliable data regarding the precipitation of the region, they suggest an aridity far more intense than other features of the region indicate. These apparent conflicts between facts and impressions can be reconciled when it is realized that small precipitation is only one of the factors that determine the characteristics of arid regions such as the Sahara or the arid lands

^{15/}Smith, P. S., and Mertie, J. B., Jr., op. cit., p. 60.

in the Basin province of the western United States. A region of small precipitation is usually pictured as devoid of water, but in northern Alaska water is almost everywhere. The surface of the country during the summer is commonly wet and swampy, and water stands on the surface in ponds and lakes. The streams . . . constantly increase in size toward their lower courses. All these features are due in large measure to the permanently frozen condition of the subsoil, which makes removal of surface water by percolation and by underground migration impossible. Furthermore, the low elevation of the sun, even during the summer, prevents rapid evaporation. The rainfall or snowfall thus stands on the surface or collects in the low areas where the slope is not sufficient to induce surface run-off. Then again, the upper 6 to 18 inches of the frozen zone melts during the summer and thus produces wet, soggy footing that is most unlike any preconceived idea of a dry country. Furthermore, the precipitation does not come in deluging cloud-bursts, separated by long intervals of low precipitation, as in the countries more often referred to as arid, but comes in numerous light showers or heavy mists."

Furthermore the gentle slopes of the arctic coastal plain and the dense, spongy tundra vegetation combine to slow runoff markedly.

Northern Alaska is windy and apparently most windy near the coast. At Barrow the average annual wind velocity exceeds ten miles per hour and it is windy most of the time. The winds are evenly distributed throughout the year and generally are easterly or northeasterly. The few observations from inland in arctic Alaska indicate that there the winds are likely

to be controlled in part by topography and blow frequently either up or down the drainages.

The plants and animals that inhabit the region of the ARL

Only a brief and very general outline will be given here of the plants and animals of the land and sea around the ARL. Much has been learned about them through ARL projects and even the generalities recorded here may now be known to be somewhat in error - at least by omission if not by commission.

The northern limit of the spruce is within the Brooks Range. The trees extend farthest north on lower, sunnier slopes and along the main valleys. Willows of shrublike character, although in places of substantial size, grow in the main valleys much farther north than do the spruce. They are present in the foothills and on the coastal plain although, near the coast, they are sparse and small. Alders, and some cottonwoods up to nearly a foot in diameter at the base, extend in a few places into the foothills province.

The interstream areas are blanketed in the arctic tundra - a thick, spongy, mat-like mass made up of grasses, sedges, mosses, lichens, and a few small bushes. The heights, especially at the higher altitudes, may be almost completely bare of vegetation. Many species of flowers blossom in wild profusion during the long days of the short summer.

Caribou wander in large herds over the arctic tundra. Up to a few years ago some reindeer were partially herded by a few of the Eskimos not far from the ARL. This practice seems to have stopped. Moose are common in the valleys of the Brooks Range and now range northward down the main streams to or near the arctic coast. The beautiful white Dall sheep roam the slopes of the Brooks Range and out onto the higher mesas and plateaus of the foothills.

The grizzly bear is not numerous but is widely distributed, especially in the foothills and the mountains. Foxes, wolves, and coyotes are widely distributed. Small fur-bearers are common but not very numerous. These include such species as the sik-sik and sik-sik-puk (ground squirrels), wolverine, mink, and marten. The Eskimos use many dogs as draft animals. The dogs are mostly small and of mixed breed.

Lemmings are cyclic and in peak years are present on the coastal plain in swarms. Birds also are numerous and of many species. These include ducks, geese, loons, the sandhill crane, hawks, terns, jaegers, plovers, longspurs, buntings, ptarmigan, jays, owls, and many small song birds.

Sea animals of many species also are present. Included are whales, walrus, hair seals, the ooguruk (large arctic seal), and fish, as well as non-vertebrates. Polar bears and foxes range widely over the ocean. The larger birds, walrus, bears, seals, whales, fish, and the fur bearers are widely used by the Eskimos although they are not as dependent as

formerly on the wildlife. The Eskimos also hunt the land animals as opportunity offers.

Human inhabitants

The native inhabitants of the environs of the ARL are Eskimos. They are concentrated principally in Barrow, about four miles from the ARL, that now has a population of about 2,000. Wainwright is a much smaller village, about 85 miles southwest of Barrow along the coast. A small group of Eskimos live permanently in the interior near the Anaktuvuk Pass and subsist on the sheep, caribou, and other resources of that region. Barrow now has a modern gravel airstrip and has experienced a recent construction boom. New hospital facilities, nurses' and doctors' quarters, schools, and teachers' apartments have been built. These are modern, up-to-date buildings in every way. They are supported by a myriad of piles frozen into the ubiquitous permafrost.

The Eskimos still trap and hunt for at least part of their subsistence. Up to around 45 are employed by the ARL and perhaps 25 more by the Air Force contractor. Some others are used in various ways as teachers, tractor operators, natural gas technicians, store owners and employees, communications operators, airfield personnel, carpenters, plumbers, and electricians in construction and maintenance operations. The numbers of salaried employees are much larger than before the start of the Navy's oil-exploration program (Pet 4). In addition to the villages, the natives also

inhabit various strategically located places intermittently or at special times of the year such as a duck-hunting camp near the tip of Point Barrow for duck hunting.

Now there are perhaps in the order of 500 white inhabitants in northern Alaska, not counting those involved in very recent oil exploration east of the Colville River. They are teachers, doctors, nurses, and other professional personnel, and skilled and semi-skilled technicians and laborers. Some are on the staffs of the ARL, of the DEW Line contractor, various federal agencies, and a variety of others. Transient persons include tourists, hunters and fishermen, ARL investigators, and others.

The Problem of Transportation

In the Arctic, including the vicinity of the ARL, the matter of moving from place to place on land, sea, under the sea, over the ice, or in the air is one of the most difficult problems and an ever present one. The frozen tundra becomes soft and soggy in summer and is perpetually frozen below the first few inches. In winter the ground is hard; the lakes and the sea are frozen but the cold, the wind and the darkness must be faced. Air travel is inhibited by inadequate navigation aids, few airfields, and by cold, fog, and wind. Movement on the sea involves an almost complete ice cover in winter and shifting, grinding ice floe in summer. Submarine transportation is possible but a problem is the ice above. Progress is

being made in solving some of these transportation problems. Knowledge is more complete, techniques have improved, communications and predictions are better, and better equipment has been developed. Nevertheless most experienced arctic specialists agree that transportation is the most important single factor affecting arctic development.

Foot travel on land is possible, weather permitting, summer or winter. Dogs and sleds are still used widely but are practicable only in winter and then only small loads can be hauled. Some of the vehicles developed in World War II have been very useful in the Barrow region. These include the weasel (M29C) and the LVT (landing vehicle, tracked). The most useful prime mover is the large tractor. Tractors are used all the year around where surfaces have been prepared or partially prepared. They are much more widely used in winter where heavy tractor trains are practicable over the tundra.

Water transportation is practicable in small craft along shore leads and rivers from perhaps mid-June through mid-August. Those same waterways are favored routes for heavy tractor hauling in winter because of relatively smooth ice compared to the open ocean or to tundra surfaces.

Ocean-going ships can reach Barrow generally from mid-August into early September but the water in some years is open for longer periods and in some years does not open at all. Icebreakers of course can operate longer and range more widely than cargo ships. Nuclear

submarines can use the Arctic Ocean under the ice to a substantial extent. The Bering Strait approach is rather shoal, the bathymetry of the ocean is not sufficiently known, support facilities are lacking, and the ice cover, much heavier and more complete in winter, all are of great concern.

Air transportation is much used. A few air strips of widely different length, quality of surface, lighting, navigation, and communication facilities are available. River bars and ocean beaches are frequently used by small aircraft for landings. And, of course, the lakes, rivers, and ocean can be used by float-equipped aircraft when the water is open. Skis make landings and take-offs possible rather widely when the ground is snow covered. Helicopters are being increasingly used for special purposes. Ice strips on ice islands have proven practicable even for certain large aircraft. However, such strips are inoperable in the summer because of surface melting.

Many of the conditions and situations mentioned in this section are included in figure 1 , a work feasibility chart first prepared about 1946 by CDR P. W. Roberts, then OICC of Pet 4.

Figure 1 . Work-feasibility in northern Alaska as improved by light conditions, temperatures, and ice conditions. Modified from Plate 2, U.S. Geological Survey, Professional Paper 301.

The Idea of an Arctic Laboratory Takes Form

Just who first proposed the idea of an Arctic Research Laboratory is not known with certainty. Certainly a key figure in the development of the thought, and very possibly the actual initiator, was M. C. Shelesnyak, then a LCDR in the Office of Naval Research. He had special interest in stress physiology, thermal regulation, human ecology, and polar research.

A number of meetings were held in various offices of the Navy Department in 1946 and 1947 and a number of memoranda were written on arctic matters and the Navy's interest therein. For example: On November 29, 1945, LCDR Shelesnyak wrote CAPT R. E. Dixon some comments on cold weather operations. That memorandum listed a requirement for "A fundamental understanding of the North country and the exploitation of natural circumstances rather than combatting them in an effort to maintain 'temperate-zone' behavior patterns." On the same date CAPT O. W. Chenault, MC, USN wrote CAPT J. J. Koob and expressed the same thought. A group of 18 Navy and Marine Corps officers met in BUMED on May 15, 1946, and discussed arctic problems, mostly medical problems, that might arise in arctic operations.

By July 1946 an Advisory Board on Arctic and Antarctic Medical Problems had been formed within BUMED. That board first met on July 18, 1946. About a month later on August 21 BUDOCKS held a conference attended by representatives of interested Navy bureaus and offices, including LCDR

Shelesnyak of the newly organized Office of Naval Research, to discuss the requirements for a 100-man arctic camp.

On August 13, 1946 VADM H. G. Bowen, the first Chief of Naval Research (CNR) sent a letter to all bureaus and offices of the Navy that he felt would be interested asking for comments on the setting up of a research laboratory at Point Barrow, Alaska. Replies were received from a number of addresses including BUMED, the Hydrographic Office, BUSHIPS, Marine Corps, BUORD, BUDOCKS, and BUSANDA. Each unit expressed concurrence in the advisability of such a research facility being established. Some of the bureaus set forth their specific interests in substantial detail. One such was BUORD. That bureau listed ten fundamental studies with which it was concerned that included aspects specifically related to the Arctic. Similarly BUMED mentioned thirteen studies related to medical aspects of arctic environments.

Nevertheless, in spite of the unanimous expressions of interest and approval, each bureau and office was careful to point out that it could not be expected to provide financial assistance. The replies of BUSANDA and of BUDOCKS are typical on this point. BUSANDA said "While Bu S & A is greatly interested in the establishment of an Arctic Research Laboratory and heartily recommends it, it is not considered feasible to participate actively to the extent of furnishing any personnel or funds." BUDOCKS' cautious statement was "Bu Yds & L will be glad to cooperate

in the establishment and organization of the proposed Arctic Research Center to the full extent that limitations on funds and personnel permit, but will not be in a position to participate actively in the research program unless funds for such purposes are appropriated in the Naval Appropriation Act for 1948."

With the strength of unanimously favorable naval opinion behind him, the Chief of Naval Research, VADM Bowen, wrote for comments on the proposed establishment of an arctic research laboratory to a number of distinguished arctic explorers and scientists. Among these were Sir Hubert Wilkins; Dr. A. L. Washburn, then Executive Director of the Arctic Institute of North America; Dr. V. Stefansson, famed arctic explorer; Dr. H. V. Sverdrup, polar explorer and former Director of the Scripps Institution of Oceanography; Dr. Laurence Gould, polar geologist and President of Carleton College; Dr. H. B. Collins, Jr. of the Smithsonian Institution; and Dr. Paul A. Siple, geographer of the Department of the Army. As might have been anticipated, all of the replies were enthusiastically favorable.

Representatives of the Office of Naval Research, the Director of Naval Petroleum and Oil Shale Reserves, and CAPT E. L. Hansen of the Bureau of Yards and Docks met on September 13, 1946 to discuss some of the practical problems that would be involved in actually establishing an Arctic Research Laboratory at the oil-exploration facility near Point Barrow. All attendees endorsed the general idea of a laboratory there

but Commodore Greenman, DNPR, was concerned that several diversified groups might undertake research at the suggested facility without appropriate coordination. Because of his concern for the progress of the oil-exploration program, the conduct of which was assigned to BUDOCKS and carried out through an Officer in Charge of Construction (OICC) at the oil-exploration headquarters in Fairbanks and to a Resident Officer in Charge of Construction at the advance base at Point Barrow, he insisted that full coordination was necessary in advance in order that the OICC or ROICC would not have to be responsible for coordination at Barrow.

Furthermore, the Chief of BUDOCKS, RADM J. F. Jelley, in reply to VADM Bowen's letter of August 13, made it clear that a research laboratory at Point Barrow must be under the administrative charge of the OICC for the Pet 4 operation and subject to the concurrence of the Director of Naval Petroleum Reserves. The Chief of Naval Operations apparently was sympathetic to this position for in a memorandum dated October 21, 1946 the CNO advised the Chief, Office of Research and Inventions (actually CNR by that date) that any correspondence relative to the Arctic Research Laboratory should be directed to the DNPR with copies to CNO and to BUDOCKS.

Coordination and communication within the Armed Services was further attained on December 10 when Dr. M. C. Shelesnyak reported ". . . the tentative and exploratory planning in regard to the establish-

ment of an Arctic Alaskan research station at Point Barrow for the conduction of basic scientific research . . ." to the Committee on Geographical Exploration of the Joint Research and Development Board.

Less than two months later, on January 30, 1947 an all-Navy conference was called by RADM Paul F. Lee, who had become CNR succeeding VADM Bowen. At that conference final plans were laid for initiating an arctic research program. On the basis of the statements of requirements from the various naval bureaus and offices, the program was to include research in climatic conditions, geographical investigations, hydrographic surveys, biological research, and medical studies.

By this time the general pattern of the operation of the planned research program was beginning to emerge. This seems to be largely the result of careful thought and planning by Dr. Shelesnyak who by that time was the Head, Environmental Biology Branch, Medical Sciences Division, ONR. This philosophy is important for from it resulted the organizational foundation on which the ARL was built and which has yielded an amazingly productive record. First Dr. Shelesnyak reviewed available material on the requirements for arctic research. Next he added to those requirements certain needs of the disciplines in which he was especially interested - physiology and human ecology. With a clear idea in mind of what needed to be done, he related the research requirements to the general or specific needs of the Navy and neatly tied these into the basic principles of operation of the ONR. Finally, he came up with a plan that was consistent with the above points, contained the stated requirements of the Navy bureaus and

offices, was coordinated with government and non-government research interests, and took full advantage of the special services and facilities available at the Navy's oil-exploration camp at Point Barrow. It was quite an order and it was well done. It worked and the results have been good!

As a start for his program, Dr. Shelesnyak used principally Problems of Polar Research published by the American Geographical Society in 1928 and Bulletin No. 1 of the Arctic Institute of North America published in March 1946 and entitled A Program of Desirable Scientific Investigations in Arctic North America. He added requirements in his special field through a paper published in Science.^{16/} Much of Dr. Shelesnyak's philosophy was set forth in a prophetic paper^{17/}, also published in 1947. In it he states that the Navy's interest in the Arctic has increased with greater understanding of the Arctic. He then points out that the Arctic is largely ocean with much deep water in spite of the intermittent broken cover of ice. He urges that the use of sub-surface vessels under pack ice be pursued and points out that the Arctic is becoming important in the flying world. He notes that ground forces and bases are maintained by the Navy and that it is necessary that the land and sea of the Arctic and Subarctic be understood.

^{16/} Shelesnyak, M. C., Some Problems of Human Ecology in Polar Regions, Science, vol. 106, No. 2757, Oct. 1947, pp. 405-409.

^{17/} Shelesnyak, M. C., The Navy Explores its Northern Frontiers, American Society of Naval Engineers, vol. 59, No. 4, Nov. 1947, p. 477.

The plan for arctic research that Dr. Shelesnyak evolved consisted of several parts, of which only one was the Arctic Research Laboratory. Another part was the compilation, editing, and writing of an encyclopedia of the Arctic. For this work the ONR contracted with Vihjalmur Stefansson. A third part was an ONR contract, jointly supported by the Navy, the Army, and the Air Force, with the Arctic Institute of North America to prepare a bibliography of all arctic literature. The Arctic Bibliography still goes on, although now supported on a broader base. Finally, the plan included the preparation of a roster of arctic specialists by the Arctic Institute. This was a sort of "Who's Who in the Arctic."

In February 1947 Dr. Shelesnyak was sent to Barrow by the CNR to study on the ground the feasibility of the proposed laboratory. Point Barrow had been tentatively selected as the site of the proposed station because of its location at the northernmost tip of U.S. territory, its typical arctic coastal environment, and the logistics available through the going oil-exploration program. Enthusiasm for Barrow increased as Dr. Shelesnyak became aware of the highly mechanized nature of the Barrow facility, the many technical activities underway as part of the exploration program, the interest and support of the petroleum personnel on the ground, and the continuing encouragement of Commodore Greenman, DNPR, and of CDR P. W. Roberts, OICC for Pet 4 in Fairbanks.

Almost as soon as Dr. Shelesnyak returned from Point Barrow he

entered into negotiations with Dr. Laurence Irving at Swarthmore College and with Dr. John W. Nason, President of the College. The President's formal proposal to ONR for " . . . a contractual arrangement . . . for the performance of research in physiology basic to the acclimatization of life to Arctic environments" was made by letter dated April 11, 1947. That letter was accompanied by an appendix that listed an arctic program made up of physiology, oceanography, ecology, and botany. Swarthmore, however, was to undertake only the physiology part and it was expected that contracts would be made with other colleges and universities for the other parts.

President Nason apparently was well pleased with the plan for his proposal letter contained the following - "I wish to indicate for the officers and faculty of the College that they view this research with great interest for its probable contribution to knowledge, and that they will support in every way possible the wise provisions of our government which enable educational institutions to join with Navy in a program of research at the important new frontiers of human experience." On May 2 President Nason was informed of approval of his proposal. There remained only the details of working out the contract.

Then began a frustrating interval of detailed planning, travel arrangements, procurement of supplies and equipment, negotiations as to what would be purchased through the contract, what would be supplied by ONR, what would be provided by Arctic Contractors (ARCON), the basic contractor

for the BUDOCKS oil-exploration contract, and a thousand and one other details.

Furthermore these details were by no means completed when Dr. Irving and his group landed at Point Barrow. Correspondence of Irving with his college and with various people and offices in ONR indicates the many complications, delays, and discouragements of getting underway a research facility of the type that Doctors Shelesnyak and Irving were attempting to launch. Under the circumstances the patience revealed by the correspondence is remarkable. The point can be illustrated by brief quotations from a letter dated August 13, 1947 (just a week after his arrival at Barrow) from Dr. Irving to Dr. Shelesnyak. He rather plaintively states "Upon inquiry at Ladd Field I learn that no information has been received about our party. I was in hope that we might receive authorization to draw upon stores of the Quartermaster and of Air Corps Supply for items needed for our work." And again "In talking with the local chief of Arctic Con. I found that he has not yet received a specific directive or allocation against which our expenditures will be charged."

Back in April of 1947 ONR had transferred to BUDOCKS \$50,000 to provide logistic support for the scientific personnel at the station at Barrow. The support would be given by ARCON through its contract with BUDOCKS. The amount was estimated as sufficient to cover housing, messing, transportation, use of equipment, and arctic clothing for 12 scientists for a year. That the amount was grossly underestimated will

become clear a little further on in the story of the ARL.

And so Dr. Irving and his little band moved quietly into the oil-exploration community in August of 1947 to begin studies of metabolism in the arctic environment. Britton^{18/} summarized the story well 18 years later when he wrote - "The intellectual vigor and imagination characteristic of the Office of Naval Research immediately following World War II stimulated recognition both of the dearth of knowledge of arctic areas and the Navy's need to understand all aspects of operating in more than 5 million square miles of arctic seas. Happily, these men of spirit, foresight, and purpose who recognized the need were able to couple ideas with action which led rapidly to the organization of both an arctic research program and a laboratory to support it."

^{18/} Britton, M. E., ONR Arctic Research Laboratory, op. cit., p. 44.

THE ARL BECOMES A REALITY UNDER LAURENCE IRVING

Research Begins

Dr. Irving did not waste much time in getting his research program underway. He was deeply concerned, of course, with developing a workable pattern within which the scale and scope of a balanced research program could grow; with working out operational relationships with other individuals and groups at Barrow, such as the ROICC and ARCON; and with the many other logistics aspects inherent in the successful operation of an isolated, necessarily self-sufficient laboratory. Nevertheless, he was a research scientist, and he wanted to get on with his research and did.

The research project of Dr. Irving, which was covered by Task Order 1 of the Swarthmore Contract in the amount of \$55,220, called for the measurement of the oxygen consumption of cold-blooded and warm-blooded animals at various temperatures, with the objective of describing their metabolic activities in relation to arctic temperatures. The program included comparison of the metabolic rates of arctic animals with the rates of temperate and tropical animals. Also included was the study of the conservation of heat through such mechanisms as insulation and hibernation.

Dr. Donald Griffin and Mr. Raymond Hock joined the Barrow group early in September, 1947 under a contract between the ONR and Cornell University. The Cornell contract, for which Dr. Griffin was principal investigator, called also for information upon the metabolism and economy of

heat whereby such birds as the ptarmigan preserve themselves in the rigors of the arctic climate. Dr. Griffin remained at the ARL for only about three weeks in the fall of 1947, but Mr. Hock stayed on.

In a memorandum dated October 1, 1947 and directed to the Director, Medical Sciences Division of ONR, Dr. Irving reported his research activities to that date. It is an impressive report consisting of just over four typed pages, but it succinctly describes what he and his people had done, what they had observed, what they thought, and what they proposed to do. Remember that the date was less than two months after the party had scrambled from their aircraft into the totally unfamiliar environment of the Arctic.

He noted that a storm, less than a week after their arrival, had brought in large numbers of marine animals such as sea anemones, coelenterates, mollus eggs, large isopods, crabs, and worms. He commented that these had been brought in from sources offshore because the near-shore areas had been scraped clean by grounded ice. Thus, he inferred productive beds offshore not yet located.

Dr. Irving reports expeditions over the tundra and the search for specimens in fresh water ponds, lagoons, and the sea. He said---"The land and water seemed to be monotonously devoid of animals, although migrating flocks of ducks and shore birds were numerous. Gradually developed familiarity with the terrain through intensive and laborious search, for travel on the tundra is difficult, has yielded a stock of animals which appear

suitable for study and has indicated that a supply may be obtained through the winter." He commented that to arrive late in the summer and then to try to find suitable forms for use in research was difficult during the three remaining weeks of the rapidly waning August arctic summer and the near-freezing weeks of September.

Then he commented on the knowledge of the environment held by the Eskimos and their ability and willingness to pass on their knowledge. This, of course, has been noted many times by explorers and scientists, but Irving was greatly impressed, for on these traits of the native inhabitants rested much of the success of his research. He said—"The sharp observation of our Eskimo assistants has been invaluable. Combined with their keen observation, their accurate memory and ability to report observations literally is making available to us gradually the careful results of their serious study of this region. The store of information which they possess, and which they can impart undistorted by fancy, will be fruitful to us during the winter."

Irving also commented on the characteristics of Eskimo clothing, especially footgear (mukluks), and stated that his party planned to study its characteristics, test it in the field, and then report on the advantages and disadvantages.

He listed as already collected two mammals (blue fox and ground squirrel), one bird (snow bunting), isopods, decapods, several fish, and

caddis flies. He anticipated that ice covering fresh water will make easy the capture of plankton under the ice, until the ice becomes too thick. He also looked forward to the drifting in of the sea ice to make possible the capture of marine fish and plankton. He noted that one large ice floe of about 25 square miles had drifted in and grounded, bringing with it about 25 polar bears. That many bears, he said, indicated a large productivity of the sea around the ice. He also reported—"Members of our party shot four bears. Since they provided near a ton of meat for the native village, their (the Eskimos') interest in science is strengthened."

Dr. Irving pointed out that already the oxygen consumption had been measured of a series of flies at Centigrade temperatures from 0° to 30° and that measurements were in progress on sculpins and a large marine isopod. Finally he said—"Respirometric methods are in preparation for measuring the oxygen consumption of animals from the size of fox to lemmings. When the metabolism of the mammals has been indicated, analyses of their insulation and hibernation can proceed. With a few series of measurements on cold blooded animals completed, it will be possible to study whether the metabolism of organs and tissues can afford analysis toward giving a view of the organized control of metabolism."

And so the ARL went into its first winter. Research proceeded throughout the winter, but Doctor Irving left Barrow on February 5, 1948 in order to return to the States to take up a variety of administrative

matters that needed attention urgently and especially to assist in attempts to broaden, strengthen, and increase the research program at the ARL. The scale and scope of Doctor Irving's energetic efforts in regard to the research program are indicated by the following items that appeared in his Progress Report dated March 31, 1948—

"1.2 Conferred with Dr. John Field, Department of Physiology, Stanford University, concerning programs of research in the metabolism of tissues of arctic animals significant in view of their operation at low temperatures.

"1.3 Presented paper on 'Physiology of Arctic Animals' at Colloquium, Division of Medical Sciences, Office of Naval Research, 21 February 1948.

"1.4 Presented paper on the Arctic Research Laboratory at meeting of Colloquium, 20 February 1948.

"1.5 Conferred with Dr. Magnus Gregerson, College of Physicians and Surgeons, New York City, on the program of the ARL.

"1.6 Conferred with Dr. G. W. Beadle, California Institute of Technology, and his colleagues on the program of the ARL, giving a seminar on 'Research in Physiology at the Arctic Research Laboratory'.

"1.7 Delivered lecture at the University of Illinois on 'The Metabolism of Some Arctic Animals': also presented seminar on the ARL. Conferred with faculty and administration upon the program of the ARL.

"1.8 Conferred in Boston with Mr. C. Lloyd Claff, trustee of the

Marine Biological Laboratory, and with Dr. George Wislocki, Department of Anatomy, Harvard University Medical School, on the program of the ARL.

"1.9 At the meeting of the Federated Societies for Experimental Biology, Atlantic City, conferred on the program of the ARL.

"1.10 At Stanford University conferred with Professor F. W. Weymouth and other members of the faculty upon the program of the ARL.

"1.11 At University of Washington conferred with Dr. Thomas Thompson, Dr. C. A. Barnes and colleagues upon the program of the ARL and particularly upon problems of oceanography and sea ice."

The efforts of Dr. Irving, of Dr. Shelesnyak, and others in the Office of Naval Research, and of the Advisory Board for the ARL, later to be discussed, were influential in stimulating interest in the ARL and its programs and in attracting more research programs in several fields to the ARL. Effective also was a short but outstanding article^{19/} that appeared in March. In that little article, Irving first described the physiological research going on and its significance. He mentioned, for example, that "The small number of species appears to facilitate obtaining conclusive results . . . The few species can be well known. They are often the sole representatives of

^{19/} Irving, Laurence, Arctic Research at Point Barrow, Alaska: Science, vol. 107, no. 2777, pp. 283-286, March 19, 1948.

large taxonomic divisions, and their lives are dominated by the cold of the arctic climate. Thus, natural conditions in the Arctic have eliminated the abundance of animal forms and environmental factors which in the tropics confuse the observer in his attempt to survey the relations between life and environment."

Doctor Irving went on to point out opportunities for productive research in human acclimatization to cold, in botanical studies around the sudden emergence of plants and animals into almost explosive summer activity, in biological and physical studies associated with the sea and especially its ice cover, in bird migrations, in the processes of transportation and deposition of materials along the arctic coast, in snow studies, and in permanently frozen ground. He concludes with the challenging statement that "Scientific exploration at the arctic frontiers, where natural forces are strong and clear, can guide the domestic operations of science in lines leading realistically forward.

"Arctic research in the past has greatly enriched our culture, and no similar extent of temperate or tropical coast line can list names and works of such distinction as those which have derived their information from exploration along the Arctic Coast of America."

Spring arrived a little late in 1948, but not much. By mid-June the tundra behind the ARL was still nearly 95 percent snow-covered, but some of the small birds—snow buntings and longspurs already were back. The

streams and lakes near the coast were still tightly ice-locked, and the ground-fast sea ice had not yet moved. Offshore though, beyond the grounded pressure ridges a mile or so away, lay a band of open water up to several miles across, and large whales had cruised through it but too far away for pursuit by the Eskimos. They had, however, taken ringed seals and ducks as well as geese and trout from inland and as much as thirty miles away along the Meade and the Inaru Rivers. Eider ducks and other species were passing in abundance. The caribou ranged far inland.

By the end of June, only two weeks later, travel along the coast was impeded by broken lake ice and soft sea ice. Landings by aircraft on either skis or floats were impracticable. The rivers were open near the coast, and some of the lakes were clear.

Around the middle of July, and the first two weeks of July had been warm and bright, the sea ice was fast for a short distance from shore but was disintegrating rapidly, and large drifting floes dotted the open water. Birds had nested, and most already had hatched young. Most flowers were in full blossom. Flies, spiders, and bees were active on the warmer days.

Thus, the ARL had burst into a typical arctic summer. So, too, had its program expanded. Instead of the two projects of the previous winter, there were in July about nine projects underway. In addition to projects under ARL administration, were several in northern Alaska that used the ARL from time to time. For example, the U. S. Coast and Geodetic Survey carried on an earth-magnetism project from the Laboratory.

Irving's Swarthmore project continued, as did the Cornell project of Doctor Griffin. Professor D. H. Campbell of the California Institute of Technology was making immunology studies of arctic animals. Doctor Victor Levine of the Creighton Medical School was determining the vitamin content of the flora and the fauna, as well as making health studies of Barrow Eskimos. Doctor George MacGinitie, also from the California Institute of Technology, was working with the marine fauna. From Stanford University, Doctor John Field had begun studies in tissue metabolism of arctic animals. M. B. Dobrin and R. R. Van Zant of the Naval Ordnance Laboratory were carrying on geophysical research. On grants from the Arctic Institute of North America, Professor Charles Wilber and X. J. Musacchia of Fordham University were analyzing tissues and blood of arctic animals for fat content, and Lloyd Spetzman from the University of Minnesota was carrying on botanical research. As of July 31, ARL personnel in residence numbered 29. Thirty-one was the authorized limit.

During the summer period of intense activity, scientists from the ARL ranged widely from Barrow on reconnaissance missions or in carrying out the specific activities of their projects. Space does not permit the detailing of such reconnaissance expeditions, but one made between June 8 and June 12 to the Anaktuvuk Pass by Doctor Irving is of special interest. He visited the native group that formerly was living at Chandler Lake. They had spent the previous winter in the timber on the south side of the Pass,

and when visited, had moved into the tundra at the north end of the Pass. He collected many specimens from them—some from their winter camp in the timber and some from the spring camp area. Doctor Irving records many details supplied by the natives and sums up by saying—"The number of birds and early date of their arrival indicate that an extensive migration comes through the pass from the South. The natives are keen observers and accurate reporters, and quickly learned to prepare bird skins. They could facilitate a rapid and thorough survey of the natural history . . . such as would be needed to establish the species, dates, and numbers in migration.

"My purpose in reconnoitering this area was to obtain live animals for our physiological experimentation and to survey the region of the pass as an eventual station in which evidence for the metabolism and nutrition during migration could be effectively studied. I believe that accurate identification of fauna and flora would be a great contribution to knowledge of distribution of life at a focal pass for migrations from the Central Alaskan valleys to the Arctic Slopes, north of the mountain barrier.

"With accurate identifications and natural history established, physiological experimentation upon migration and hibernation could make rapid and penetrating progress . . ."

In his Progress Report for August 31, 1948 Doctor Irving selected several of the projects for special comment because of their possible use

in planning later research. He pointed out that Professor MacGinitie's project had accumulated more than 200 marine invertebrate species, and predicted that his work would lead to many later projects of scientific and practical value. Doctor Levine's biochemical surveys of the Eskimos have highlighted many of their problems of health. Further scientific studies of the health and diseases of the Eskimos would be of great advantage to the local people and would advance medical science.

Doctor Irving noted that Doctor J. H. Swartz, geophysicist of the U. S. Geological Survey, had used the ARL while making temperature measurements in holes drilled for oil exploration. His results will be most useful in permafrost research. The botanical survey by Lloyd Spetzman, who accompanied a Geological Survey party from Lake Schrader (far to the east of the ARL) down to the sea, should be continued.

Vladimir Walters' partial collection of fish from the sea, rivers, and lakes should be completed and followed by museum studies for final identifications. Doctor Neal Weber came late in the season and collected many insects from Barrow, Umiat, and the Anaktuvuk Pass. The work, which needs to be carried on further, is a large contribution to arctic entomology. Finally, Doctor Irving outlined for the next year the desirability of an integrated survey of the Anaktuvuk Pass area by Weber (insects), Spetzman (flowering plants), Dr. George Llano (lichens), and Thomas Brower (birds).

With the coming of fall, the days grew rapidly shorter and the temperature dropped as the ARL settled in for its second winter of research. In November the highest temperature was -2°C , the lowest, -40°C . The locale lived up to its windy reputation with velocities up to thirty-one miles per hour, and a monthly average of ten miles per hour. The summer residents left, and the "in-residence" strength at the end of November was reported as twelve.

The Scientific Director in October was called to the States on his many duties connected with the ARL; he attended a meeting of the Arctic Research Laboratory Advisory Board in Washington on October 18; and his duties at the ARL were assumed by Harald Erikson, a scientist on the Swarthmore contract.

Many changes were in store for the administration of the ARL by the next summer. Doctor Irving completed his tour and was relieved by Doctor George MacGinitie as of July 1, 1949. A thumbnail statement by Doctor Irving about the ARL, the opportunities he found there, and his prediction for the future is found in one of his reports made in the fall of 1948. He said—"In conclusion, I will remark that the diversity and intensity of research at the Arctic Research Laboratory has been productive of results and stimulates further inquiry into problems of Arctic science. The laboratory facilities and its support are well adapted to research. Considering the novel and special interest afforded by the problems of arctic

research, the Arctic Research Laboratory can offer splendid opportunities for pioneer work of highest quality. I would not hesitate to recommend that its facilities be offered to and reserved for the most important and thoroughgoing research by the most competent scientists.

"For me as scientific director, it has been stimulating and satisfying to be connected with the development of this facility and with those who have shaped its course. I am grateful to the Office of Naval Research for the opportunity to be associated with such a scientific project, for which I see a future prospect of great value to science and of value in the useful development of the Arctic regions."

Trials of a Scientific Director

The lot of the Scientific Director of a field laboratory isolated thousands of miles from its authoritative source of direction is not an easy one. This was true, even to a greater degree than usual, in the case of the Arctic Research Laboratory. Consider some of the factors—

1. A scientific program had to be developed, staffed, and integrated. Sources were all in the States, a long way off.
2. The environment was austere and unfamiliar to the scientists.
3. Transportation to and from Barrow and in the operating area was difficult, unreliable, and frequently dangerous.
4. The ARL was, in effect, a guest facility in a bustling oil-

exploration camp. Frequently, services were provided or withheld in direct relation to the tact and persuasiveness of the director.

5. Communications were sometimes slow and unreliable.

6. Working relations had to be established and maintained both with the local Naval representatives of the Bureau of Yards and Docks, and with the civilian contractor for the oil-exploration program (ARCON).

7. Policy, guidance, and financing came from ONR in Washington and to some extent, from the ONR Resident Representative in Philadelphia.

8. Buildings and facilities for working and living had to be obtained, modified, and fitted out.

9. The Scientific Director's home institution, in this case Swarthmore College, had to be kept informed.

10. Human relationships and the morale of personnel had to be watched with care.

The Scientific Director was a busy man, but an extraordinary amount of good research was performed, and the ARL did become a well-established, going concern. The major areas of concern to Doctor Irving seem to have been—first, liaison with ONR in regard to policy, financing, communications and transportation; second, with ARCON and the ROICC for buildings and local logistics; third, the development of new projects; and finally, the performance of his own research.

Guidance from the ONR

As plans for an arctic research laboratory were developing, Doctor Shelesnyak early in 1947 began to cast about not only for desirable research projects to be pursued, but also for some appropriate individual to direct the program in the field through a contract of some sort with the individual's home institution. Soon, contact was made with Doctor Irving at Swarthmore College, and the two scientists as early as March, 1947, began to evolve a pattern. This included the general parameters of the research program of Doctor Irving, the terms and conditions of a contract that Swarthmore might propose to ONR, and other possible projects to be directed by other scientists. Arrangements were begun by Doctor Shelesnyak for the obtaining of equipment that would be needed.

Something of the nature of the problems encountered were set forth in a memorandum dated July 17, 1947 from the Resident Representative of the Office of Naval Research in Philadelphia to the Chief of Naval Research. That memorandum discussed in some detail some of the bewildering complexities in connection with mail service to Point Barrow from the east coast, transportation of equipment and other items by Naval Air Transport Service (NATS) and commercially, transportation of persons by NATS, insurance for civilians under contract, procurement of equipment, and other matters.

The Resident Representative in Philadelphia referred to above was Paul H. Kratz who reported to the Branch Office in New York of the Office

of Naval Research. Many of the problems in connection with establishing the Arctic Research Laboratory and in keeping it going, fell on his shoulders, and he did an outstanding job. Doctor Irving was so impressed that even before he left for Alaska, he wrote on July 31 to the Commanding Officer of the New York Branch Office of the Office of Naval Research a long letter of sincere appreciation.

By October, some of the normal and predictable problems of groups working in isolated situations began to be apparent. Also, the scientists were beginning to find out some of the facts of life long recognized by construction personnel at the oil-exploration camp. Irving, speaking for the group, bluntly put it to Doctor Shelesnyak in a letter dated October 1. "There is another matter to consider at leisure—the pay scale of our personnel in contrast with that prevalent here. The lowest rating that the Contractors have is about \$400 per month, which is exceeded by only two of our staff. Army, Navy and other service personnel on duty here likewise are pinched by their pay schedule, but for them it is part of a career which allows for foreign service. For us, it is a rather occasional occupation. Our people do not complain, but I think that any future planning should consider that part of the subject free from the silly inhibitions which have prevented academic personnel from receiving decent wages. The prestige of a decent income is as important as the dough, and in considering a research establishment, it would gain respect if it were indicated that its

personnel would receive compensation to recognize their ability."

Doctor Irving made a hurried journey to the States in November on ARL business, but was back in Barrow in December. As the New Year started, he apparently was seriously concerned about several aspects of the ARL—the policy of ONR, the future research program, and the desirability or not of a continuing relationship with Swarthmore College.

According to L. O. Quam of the Office of Naval Research,^{20/} "In February, 1948 the Arctic Research Laboratory was officially established to provide facilities at Point Barrow for fundamental research in all appropriate scientific fields related to the arctic environment, and to afford facilities as a base for field studies in arctic Alaska. From its beginning, ARL was conceived a national facility. The charter states 'It is expected that the programs will be largely initiated by competent groups in and out of government and that some will be supported by ONR and some by others.'"

Also by letter, dated February 10, 1948, RADM P. F. Lee, CNR, formally designated Doctor Irving as Scientific Director. He was charged with planning for modifying, furnishing, and equipping the ARL; with proposing methods of scientific research and management; with acting as scientific director of authorized programs; and with arranging with the OICC, methods of local management and operation.

^{20/} Quam, L. O., personal communication.

Efforts to amend the Swarthmore contract had been underway for a long time, and on February 18, 1948, President Nason officially requested an amendment that would increase salaries by 25 percent and also would increase travel funds and equipment funds. The request was approved.

Meanwhile, Irving's relationships with Swarthmore College appear to have deteriorated, and some inquiries were made as to another institution to take over the ARL. The file contains a letter dated March 9, in which the Chairman, Division of Biology of the California Institute of Technology, regretted the inability of that Institute to become the host organization for the ARL. On March 24, Irving wrote President Nason of Swarthmore, and enclosed material that could be used for an extension or renewal of the contract. At the same time, he indicated no further need for laboratory space at Swarthmore, but the continuing requirement for a small business office. In regard to his own time, he said "I think that sabbatical leave is due me in fulfillment of the understanding upon which I was employed. Since you interpret differently, I will obtain advice from the AAUP and at law, and inform you if my view is sustained."

The material sent to President Nason also was forwarded by Irving to Paul Kratz for his information. The proposed request for support was for "research in expeditionary physiology with emphasis upon work at the Arctic Research Laboratory." The text makes it clear that Doctor Irving visualized work far broader than just at the ARL. In addition to the use of

such phrases as "The program calls for the performance of basic physiological research in arctic, desert and tropical situations . . .", the proposal specifically includes provision for comparative work in the Panama Canal Zone and at the Santa Rita Experiment Station in Tucson, Arizona. This was a point that was accepted at that time, but led to wide differences later on. The proposed continuation was for a full year, from July 1, 1948 through June 30, 1949, and the total estimated amount needed was \$129,380.

President Nason met with Captain C. W. Shilling, Director of the Medical Sciences Division of ONR, on Good Friday, 1948, and apparently agreed to propose that Swarthmore continue as the contractor in spite of the difficulties that had arisen. Swarthmore's formal proposal was made on April 10, and word of acceptance was dated April 28. So it was agreed to go on for another year from the end of the first contract period.

Meanwhile, the OICC in Fairbanks submitted an estimate that a total of \$248,830 would be needed to pay ARCON for the support of the ARL during the full calendar year 1948. Some of this already had been expended at the time of the estimate.

On April 30, the Scientific Director submitted to the CNR a long letter that traced the key steps in the establishment of the ARL up to that date. He mentioned salient points in planning, noted the formation of an Advisory Board, outlined the fiscal situation, and briefly reviewed the

scientific program. As summer approached in northern Alaska, the plans and preparations proceeded for a larger research program than had been carried on the previous year. An increasing tension developed between the OICC and the Scientific Director, so that some arrangements were made with difficulty and lack of satisfaction on both sides.

About mid-June, the Scientific Director put on paper a good deal of his interpretation of the situation in a 4-page, single-spaced letter to the Acting Secretary of the ARL Advisory Board. The establishment and operation of that board (ARLAB) will be discussed later in this chapter. In that letter he records "We have encountered delays in obtaining support from the O in CC because of his question of authority and instructions." Doctor Irving's recommendation was the designation of a Naval officer to provide liaison between the OICC and the Scientific Director. As he put it—"I would only add that the nature of the ARL operation, requiring service support, requires transmission of directions for support in service language and verification of accomplishment of support as can only be done by a line officer responsible to ONR."

And in the same letter in regard to future programs, he said—"On account of organization problems encountered in the spring, I have not been in position to examine extension into new fields, nor has ARLAB been able to guide the program. For similar reasons, I believe, ONR has not set a policy leading toward long range commitments.

"At present I cannot see means of expansion of the program in the physical sciences as was contemplated in our original plan . . .

"I suggest that the question be asked whether ONR wishes to develop research in the Physical Sciences or let the subject ride."

In an attempt to clear up some of the misunderstandings between the OICC and the SDARL and especially in the hope of devising better procedures and working arrangements, Doctor Shelesnyak went to Fairbanks and Barrow in July. He held discussions in both places and some improvement of procedures did indeed result, but the problems were by no means completely resolved.

Also during the summer, attempts were made to find a patron or sponsor from among various educational institutions to take over the Swarthmore contract that was not proving entirely satisfactory. It was hoped further that any new contractor would take on also the small contract for the operation of the Advisory Board. Stanford University, the University of Pennsylvania, and others were considered, but all such attempts came to nothing. A little later, on September 9, Doctor Shelesnyak informed Irving of mentioning to Doctor D. W. Bronk, President of The Johns Hopkins University, the possibility of Johns Hopkins taking over the ARL contract.

On September 3, Rear Admiral T. A. Solberg, who by that time had relieved Rear Admiral Lee as Chief of Naval Research, wrote Dr. Irving and congratulated him on his cooperation with CAPT C. W. Thomas,

commander of the icebreaker USCGS Northwind, when she was in the area of the ARL. Throughout the summer, ONR had been trying to arrange a visit to the ARL of Paul Kratz of the Philadelphia office. By September 21, a specific request was sent by the ONR to the New York Branch Office that Kratz be sent. Irving had long been trying to get Kratz to the ARL to work on many of the business details of operation.

Only two days later, September 23, the Scientific Director of the ARL penned by hand a long letter to Doctor Shelesnyak that expressed abundantly his discouragement, frustration, and impatience at the way things had been going. In short, he was fed up, and it was plain that he would not wish to remain at the ARL much longer. For example, he said, in effect, that he found it impossible to operate effectively; there was no longer any need for Kratz to come to Barrow; he would consider a continuation of the contract only to complete results; there would be no point in his coming to the next Advisory Board meeting, etc. His understandable frustration, however, did not dim his justifiable pride in the ARL and its scientific status.

From about that point on, relations between the Scientific Director (DARL) and the ONR (really with Doctor Shelesnyak, Head, Human Ecology Branch, Medical Sciences Division, under whom the ARL was operated) deteriorated rather rapidly. It is a little difficult to put the finger on the real problem, but apparently, it was an honest difference of philosophy of

what the ARL was and where it should be going. The SDARL apparently viewed the real objective as "research in expeditionary physiology." Thus, the ARL, while requiring a certain emphasis, was only one point of interest, and work would be justified and expected at other places in the deserts, the tropics, or anywhere desirable. Doctor Shelesnyak, on the other hand, had the ARL to justify continually, based on the Navy's interest in the Arctic. While sympathetic to Irving's view, he could not defend the ARL on that basis. So on December 28, 1948 Shelesnyak wrote Irving and put the matter plainly—" . . . I have given a great deal of thought to the matter of personnel at the laboratory and the program in the Arctic as influenced and related to expeditionary research in other parts of the world.

"I am firmly convinced and feel definitely that for the time being, certainly insofar as this spring is concerned, no further departures of staff to tropical or semi-tropical regions should be contemplated. The future long range planning and direction of the Arctic Research Laboratory is extremely dependent at this moment upon the activities engaged in at the laboratory for the next several months.

"I do not wish to embark upon a long discussion of basic philosophy nor a reiteration of our various discussions regarding that matter beyond emphasizing that orientation of this program at present is basically Arctic, and supplemental aspects, although considered valid and important, are not primary . . ."

Only a few days later, the last day of December, Doctor Shelesnyak received a copy of a letter Irving had written to a colleague in which he said—"In particular I have to think that I am now a sort of physiological mercenary whose apparent freedom is supported by the Office of Naval Research under the particular control of Shelly." Doctor Shelesnyak did not like that—and said so.

A month later, Doctor Shelesnyak wrote Irving again, in much the same vein, but in even stronger language. Doctor Irving's reply was predictable. He wired—"Your letter Jan. 26 shows misunderstanding of our positions and functions. If you must continue to express opposition to my program, no further collaboration is possible. Will direct ARL only if assured your loyal and effective support." Doctor Irving also wrote on February 12, 1949 to the Chairman of the Advisory Board and defended his understanding of the situation.

By the latter part of February, the SDARL was in the States on ARL business, and Doctor Harald Erikson was acting at the ARL. Mr. Kratz wrote Erikson to tell him that negotiations to take over the ARL contract were underway with a university with a strong graduate school. In that letter Kratz effectively and sympathetically summarized the administrative storm that had blown up. He said—"At the present time I am perturbed by the fact that Dr. Irving has indicated to Dr. Shelesnyak that he will probably not continue in his present position as scientific director beyond

the commitments which he has made now ending in August. The Advisory Board and the Office of Naval Research have in general specified that the predominant interest and emphasis of this program must be in the Arctic for the present and the funds which now finance this total program are funds which have been earmarked with the Arctic emphasis in mind. Therefore, until more funds or additional funds from other sources are available, the immediate pursuit of related expeditionary work must remain in a secondary place. This is a problem about which Dr. Irving feels very strongly but the Office of Naval Research, in order to obtain additional funds to allow amplification of this program into the larger field of expeditionary work in general, must present an active and strong piece of work already performed with existing funds. There is no real incompatibility between the points of view held by Dr. Irving and by the Advisory Board. The difficulty seems to be one of mere timing, based upon the funds, personnel and interest now available."

As early as mid-February, discussions and correspondence began within ONR and between representatives of ONR and other groups such as the OICC at Fairbanks of the possibility of a meeting of the Arctic Research Laboratory Advisory Board to be held at the ARL some time in May. This finally was arranged, a special aircraft was assigned, and the meeting was held.

Also over the winter and early spring, a detailed booklet was prepared called "Information Handbook for Contractors and Prospective

Contractors for Research Projects at the Arctic Research Laboratory."

This was a most useful document.

On March 10, the Chief of Naval Research requested the CNO to arrange for the designation of the ARL as a Naval activity by the Secretary of the Navy. This was accomplished by order dated April 14 of Acting Secretary of the Navy, Dan A. Kimball. The order stated that the ARL is a subordinate activity of the ONR; is under the military command of the Commandant, Seventeenth Naval District exercised through the Civil Engineer Officer in Command, Naval Petroleum Reserve No. 4; and under the management control of the Office of Naval Research. On April 29, by authority provided in the order, the ONR defined the mission of the ARL "To conduct fundamental research related to arctic phenomena."

There was a good deal of friction over the winter between the SDARL and the ONR, in large part in the handling of financial affairs. The problem of the SDARL was to keep himself informed of the funds made available and the status of those funds. Finally, apparently in desperation, he wired as follows to Doctor Shelesnyak—"Informal note indicates Dr. and Mrs. McCarthy due April 1. No information yet received sufficient to estimate whether we can provide them with facilities needed. Can not receive them until I know adequacy of preparations and funds."

On March 29 he wired again, this time to the Chief of Naval Research. The wire contained the following—" . . . I disapprove transportation to

ARL of additional personnel until notified funds are available to discharge commitments" This was too much for CNR and a quick reply said "ONR and DNPR have authorized the personnel we are sending. Position of SDARL does not allow negation of ONR and DNPR approved personnel and projects. Responsibilities for fiscal support not, repeat not, that of SDARL."

About the end of April, Doctor Shelesnyak reviewed the amounts that had been transferred to BUDOCKS for the support of the ARL to that date and anticipated for the fiscal year (1950) starting on July 1, 1949.

In summary, he found—

From 1947 funds	\$ 50,000
From 1948 funds	137,000
From 1948 funds	20,000
From 1949 funds	82,000
Anticipated From 1950 funds	165,000

The above figures, of course, do not include the cost of the research itself, only the amounts available to BUDOCKS for ARL support.

At about the end of April, there apparently was some reorganization within ONR, for Doctor Shelesnyak then began to sign over the title—Head, Ecology Branch, Earth Sciences Division, instead of Head, Human Ecology Branch, Medical Sciences Division.

The process of termination of the operating contract with Swarthmore College went on into June, when it was completed. Concurrently,

negotiations proceeded with The Johns Hopkins University to take over the management and operation of the ARL.

The general plan in regard to Johns Hopkins was called to the attention of Doctor Erikson at the ARL by Doctor Shelesnyak in a letter dated May 9. He said " . . . the Johns Hopkins University has proposed to the Office of Naval Research, a program for the operation of the Arctic Research Laboratory, and in addition, certain research activities of the scientific director. In view of the fact that the Board and the Office of Naval Research are of the opinion that the residence requirement for the scientific director shall be of definite residence in the area for a minimum of nine months per year and that Dr. Irving does not feel that he can meet this requirement, that the direction of the laboratory as being contemplated, will be under Professor George MacGinitie, who will be on leave from California Institute of Technology with an appointment from Johns Hopkins. MacGinitie's research work will be under a special contract."

The ending of the Swarthmore relationship was discussed on June 20 at Swarthmore by Doctor Irving, Mr. Paul Kratz, Doctor Shelesnyak, and President Nason. It was agreed that the contractual relationship, not including the management of the ARL, would continue until August 31 to give Doctor Irving's group a chance to complete research reports. President Nason made it clear, and restated this in a letter dated June 29 to Doctor Shelesnyak, that—"A year ago this past spring the college offered to

continue the contract for another year as a convenience and a courtesy both to the Office of Naval Research and to Dr. Irving who wanted to continue the program. . . . Dr. Irving's connection with Swarthmore College was a purely nominal one and extended for one more year as a convenience to you and to him . . ."

However, the new arrangement with Johns Hopkins was not to be reached easily. The situation is well summarized by Doctor Shelesnyak in a letter written on June 30, the last day of the old arrangement, to CDR George Fischer, the OICC at Fairbanks, who needed to know in order to fulfill his responsibilities. " . . . on April 14, SecNav established the U. S. Navy Arctic Research Laboratory as an activity and indicated that the Chief of Naval Research would appoint an Officer in Charge. It had been our plans to contract with a University, in this instance the Johns Hopkins University, for the operation of the Laboratory and for the selection of a mutually agreeable scientific director who would be the acting Officer in Charge. As we entered into the negotiations, however, our legal counsel objected to the delegation of the operation of an activity by contract and insisted on either a change in the activity to a facility and then contract with the University for the conduct and coordination of Arctic Research with the facility as government furnished equipment or for the operation of the Laboratory by a Civil Service group. The latter proposal was not acceptable to the scientific group of the Office of Naval

Research and although for six weeks we attempted to work out a compromise, we finally, during the middle of this week, reached an agreement that we would arrange with the Johns Hopkins University to do the research, coordination and research management, and the Laboratory would be a government furnished facility. This is essentially a refined and more stabilized procedure, not basically different, however, than the Swarthmore contract except that it is more clearly defined in the statement of the role of the University and the research coordination, management, etc.

" . . . we had envisioned the role of Scientific Director, acting as Officer in Charge, and had actually asked Professor MacGinitie if he would be willing to accept the post. However, this will not be carried out, and MacGinitie will be an employee of the Johns Hopkins University which is under contract with the Office of Naval Research and will have the status of Scientific Director, or director of the Laboratory, who although being a direct employee of the University, will be guided by the Scientific Officer of the Office of Naval Research and will act as a liaison between the University, the Office of Naval Research, and Pet #4."

The ARL acquires an Advisory Board

The first thought of an advisory group of some kind seems to have been that of Doctor Irving, who in a letter to Doctor Shelesnyak on August 13, 1947, when he had been in Barrow only a few days, suggested that

Shelesnyak might wish to "consider establishment of a governing body on policy and selection of investigators to make possible choice of the best fitted scientists on most important programs from various institutions, service departments, etc. - keeping entirely to research as the primary target." The subject must have been on Irving's mind, for on August 18, less than a week later, he wrote to the OICC at Fairbanks—" . . . I recommend that the Office of Naval Research be asked to consider the establishment of a Scientific Advisory Board for the Arctic Research Laboratories. The Board should include representation from the services, departments and organizations concerned, but I believe that it should include a majority of eminent scientists whose primary concern is for scientific research and who are not obligated to represent any single service, department or organization.

"In order to formulate policy and organization of the Board, I recommend that a conference of representative scientists be convened. In setting the program for this conference, I recommend that Dr. M. C. Shelesnyak, Office of Naval Research, be considered well fitted by his knowledge of Arctic science and scientific organizations to study the subjects of the meeting and prepare an agenda. He will probably wish to consult such organizations as the Arctic Institute of North America, the Joint Research and Development Board and the National Research Council, as well as scientists with knowledge of Arctic Research and appreciation for its place in our national welfare."

Appropriate and useful as Irving's thoughts were, it is curious that the memorandum was sent to the OICC of the oil exploration program who was not at all involved in the organization or interests of the ARL, except, of course, in applying such research results as might be of use in the oil-exploration program.

By mid-October Doctor Shelesnyak had considered the proposal for an advising group and so wrote Irving. He was even then giving consideration to names of persons who might be invited to serve. The decision was made early in 1948 to appoint a board, and invitations were sent on March 15 by the CNR, RADM Lee, to seven individuals outside ONR. All accepted. They were—

Commodore W. G. Greenman, USN, Director, Naval Petroleum

and Oil Shale Reserves

Ellis A. Johnson, Headquarters, U. S. Air Force

Remington Kellogg, U. S. National Museum

John C. Reed, U. S. Geological Survey

Roger Revelle, Scripps Institution of Oceanography

J. Frank Schairer, Carnegie Institution of Washington

Alexander Wetmore, Secretary, Smithsonian Institution

Also considered members were Laurence Irving and M. C. Shelesnyak.

The invitation letter stated that the group would be called the Arctic Research Laboratory Advisory Board. It also stated the purpose—"The

Arctic Research Laboratory Advisory Board is established in order to have sound advice and guidance for the operation of the laboratory and for the scientific research work conducted under contract with Universities and by Federal agency research groups."

And so the Board met for the first time on March 15, 1948, and were briefed by RADM Lee, Commodore Greenman, Doctor Shelesnyak, and others. Doctors H. U. Sverdrup and V. Stefansson were consultants at that first meeting.

The Board designated John C. Reed as Chairman and Doctor Shelesnyak as Executive Secretary. It also discussed functions appropriate for the Board to consider and means of operating and financing the Board. Approximately two weeks later, an apparently self-designated Executive Committee of the Board met at the request of Dr. Shelesnyak. The Executive Committee was constituted of the Executive Secretary and the Chairman of the ARLAB and the Scientific Director of the ARL. The Executive Committee drafted for Board consideration several position papers on the organization of the Board, including ones on Board duties, procedure for review of proposed ARL projects, need for and proposed duties of a Board Secretary, and a budget for Board operation. The Committee additionally proposed a formal statement of policy in regard to the ARL and defined proposed duties of the Scientific Director.

On April 22, 1948, the ARLAB met again and in deliberations requiring eleven pages of minutes —

1. Defined its functions;
2. Approved a procedure for reviewing proposed projects;
3. Approved a proposed secretarial position and defined the duties;
4. Approved a proposed ARLAB budget;
5. Adopted a policy statement for the ARL;
6. Approved a list of recommended duties of the Scientific Director;
7. Accepted a report from the SDARL;
8. Listened to briefings on the cost of support of the ARL by representatives of BUDOCKS and recommended the construction at the ARL of two new research buildings;
9. Postponed for additional information approval for construction of special magnetic-studies buildings at the ARL;
10. Accepted the estimates of BUDOCKS for support costs of the ARL for calendar 1948;
11. Recommended to ONR that BUDOCKS be represented on the ARLAB;
12. Approved estimates for the operation (as distinct from support costs) of the ARL from July 1, 1948 through June 30, 1949;
13. Recommended continued close liaison with the Research and Development Board of the Department of Defense;
14. Heard brief descriptions of fifteen going and proposed research projects and approved most of them in principle;

15. Discussed a check list of information on proposed projects;
16. Agreed to plans for starting an ARL library;
17. And received comments from two Canadian visitors at the meeting.

It was a busy board that day, and in retrospect, it seems to have concerned itself at monotonous length with details of organization, administration, and budgeting—perhaps largely outside the scientific competence of the Board. It passed over rather lightly any real appraisal of research projects and proposals. On the other hand, the Board did use its time in considering the problems that were current or were anticipated in regard to the ARL. Furthermore, most of the Board members were not only research scientists, but also men of broad administrative experience in or out of government.

Twice again the Executive Committee met during the summer of 1948—once in July at the ARL, and once in August in Washington. The July meeting considered a number of current matters, but the August meeting was especially significant because it considered and furthered the plan to ask the Smithsonian Institution to enter into a small contract with ONR to operate the ARLAB.

The Board met for the third time in Washington on October 18. RADM T. A. Solberg, who had replaced RADM Lee as CNR attended. Also, since the second meeting Doctor Detlev Bronk, President, The

Johns Hopkins University had been added to the Board. The Board recommended that CDR R. B. Morris of the CEC, but billeted in ONR, be made a Board member. Matters similar to those previously discussed were considered, and appropriate action taken. Of special interest was a discussion of whether or not the ARL should be made a Naval facility. The Board recommended in the negative.

The Executive Committee met in December, 1948 and again in January, 1949 to review and guide progress on old items of business, and to consider new items as they arose. It will be recalled that this was in the interval when some of the problems of the SDARL were most acute. By February, it was apparent that the Board would have to consider urgent problems, and on February 8 an emergency meeting was called. Some of the members could not be reached on short notice, so the attendance was small. There was spirited discussion of the problem of a new contract for the operation of the ARL at some other institution after the Swarthmore contract expired. Also frankly discussed was the key point of the difference between Doctor Irving and the ONR—actual presence at the ARL most of the time, and the extent to which corollary studies might be carried out at points distant from the ARL and even in the tropics. The ARLAB clearly subscribed to the position taken by the ONR. The SDARL was unable to get to the meeting until almost its end, but he was informed of the tenor of the discussion.

Even with the harassing difficulties that have been mentioned—the different viewpoints of the ONR and the SDARL, the need to develop a new contractual arrangement for the operation of the ARL, and the fact that the rush of the spring season was already beginning to complicate operations, both of the ARL and of the oil-exploration work in Pet 4—it was decided to go ahead with planning for an ARLAB meeting at the ARL in May. It was felt by all that the Board needed to see for itself the ARL and the environment.

The meeting was held in the ARL on May 17-19, and it proved to be most useful. The group travelled from Washington to Barrow and returned in an assigned Navy aircraft, a Constellation. Members of the ARLAB and alternates included—

Dr. John E. Graf, Assistant Secretary, Smithsonian Institution,
vice Dr. Alexander Wetmore;

Commodore W. G. Greenman, Director, Naval Petroleum and
Oil Shale Reserves;

Dr. Laurence Irving, SDARL;

Professor Owen Lattimore, Director Walter Hines Page School
of International Relations, the Johns Hopkins University, vice Dr. Detlev
Bronk;

Dr. Walter H. Munk, Oceanographer, Scripps Institution of
Oceanography, vice Dr. Roger Revelle;

Dr. John C. Reed, Staff Geologist, U. S. Geological Survey;

Dr. J. Frank Shairer, Carnegie Institution of Washington;

Dr. M. C. Shelesnyak, Head, Ecology Branch, ONR.

Others in attendance by invitation included—

Professor George Carter, Head, School of Geography, the Johns Hopkins University;

Dr. John Field, Physiology Department, Stanford University;

Professor G. E. MacGinitie, Director, William G. Kerckhoff Marine Laboratory;

Dr. S. R. Galler, Head, Biophysics Branch, ONR;

LCDR E. P. Huey, ONR;

Dr. T. J. Killian, Science Director, ONR;

Mrs. Yvonne Reamy, Adm. Asst. to Executive Secretary, ARLAB;

Mr. Graham W. Rowley, Chief, Arctic Division, Defence Research Board, Canada;

Dr. D. Y. Solandt, Arctic Research Advisory Board, Defence Research Board, Canada;

Dr. A. L. Washburn, Executive Director, Arctic Institute of North America.

The ARLAB, in addition to handling ARL business during a series of formal sessions, made considerable effort to view research in progress, investigate the local environments especially in terms of research

potential, discuss local situations with ONPR and BUDOCKS personnel, representatives of ARCON, local inhabitants, and local representatives of other government agencies such as the Bureau of Indian Affairs, the Weather Bureau, the Alaska Communications System of the Army, the Coast and Geodetic Survey, and the Bureau of Standards.

The ARLAB was briefed, especially by the DNPR and the SDARL. It was informed that The Johns Hopkins University had made a proposal to enter into a contract with ONR for the operation of the ARL, and after detailed discussion, recommended to ONR that the proposal be accepted. A discussion on housing, although it reached no formal conclusion, indicated that most of the Board felt that the housing both for living and working quarters should be improved.

A number of announcements of far-reaching significance were made to the Board. Dr. Irving would be leaving as SDARL on June 30, 1949 and would be relieved by Dr. G. E. MacGinitie. Dr. Shelesnyak would leave ONR during the summer to take over on or about September 1 a new office that the Arctic Institute of North America was planning to open on the campus of The Johns Hopkins University. Dr. Shelesnyak would be replaced in ONR by Dr. John Field. A different team would occupy the field in the fiscal year starting July 1, 1949.

At the start of the fourth meeting of the ARLAB at Barrow, it was decided that the going and planned research program would be considered

in detail during the meeting by a series of specialized committees in order to make reasonable progress in the appraisal of the whole program. The committees were made up of all those present, regardless of whether they were guests or members of the ARLAB. There was a Committee on Oceanography, one on Medical Research, and one each on Biology, Geophysics and Geology, and Anthropology and Social Sciences.

No attempt is made here to record all the recommendations of those ad hoc committees, but a few points of special interest are selected from the various committee reports. The Committee on Oceanography reported in part—"It is regrettable that present oceanographic work has largely been confined to studies of the shelf, when so little is known about the Arctic Ocean. The fundamental oceanographic work in little known regions has been to measure the distribution of temperature and salinity with depth, and from it, to compute circulation. The measurement of temperature and salinity from ice drifts has the disadvantage of leading to oceanographic section parallel to the currents, whereas the most meaningful sections are perpendicular to currents. To obtain controlled sections perpendicular to currents, one might, in winter, be able to establish airborne oceanographic sections covering, perhaps, the region from Barrow to the Pole. This is largely a problem of logistics, and furthermore, one that is not peculiar to oceanographers, but will have to be considered for any type of studies in the Arctic Basin. The committee

recommended that this Board energetically pursue this problem on the appropriate level, and to help designate the most suitable agency for organizing an airborne arctic expedition."

The Committee on Biology said that—"The Ecological Studies of Marine Fauna proposal, with Professor MacGinitie as principal investigator, was considered excellent. The committee felt in connection with this, it might be important to encourage projects in limnology. The work might have very important applied aspects."

The report of the Committee on Anthropology and Social Sciences contained the following—"The committee raised the question as to whether the Board should consider the fact that social sciences are, thus far, on a lower level than natural or physical sciences. From the point of view of a number of interests, it is not too early to make an attempt to raise the social sciences somewhere nearer the level of the natural and physical sciences.

" . . . Social sciences need not neglect economics as the committee feels it is within the proper framework of social sciences."

The meeting at the ARL was the last meeting of the ARLAB before the new administration took over on July 1.

Frustrations in housing the ARL

It already has been pointed out that the SDARL had to deal on the ground with a variety of people and interests and for a variety of purposes.

The types of concern included financial affairs; the transportation of supplies, equipment, and instruments; transportation of ARL personnel; arrangements for the provision of buildings both for living and working at the ARL; and the supervision of research projects going on, including his own. His business was with various representatives of the Navy at the ARL, usually the ROICC at Barrow and the OICC in Fairbanks; of ARCON; of other federal agencies carrying on research or supplying services in the area; with the Eskimos of Barrow and Anaktuvuk Pass; and with ARL scientists and visiting scientists from time to time.

The so-called "Navy Camp"—the field headquarters for the oil-exploration program—was on a stretch of beach composed of coarse sand and limited on the landward side by the edge of the tundra. Transportation back and forth to Barrow was along the beach — there was no road as such, although in places the beach had been improved and partially stabilized for travel. Most of the buildings were of the quonset type, generally either 20 feet by 40 feet or 40 feet by 100 feet.

On their arrival at the site in early August, 1947, Irving and his small group immediately were assigned a 20 by 40 foot quonset hut, No. 259, that was used briefly both for laboratory and living. Within a week or so, the adjacent 20 by 40-foot building, No. 260, was assigned and was, thenceforth, used for living so that 259 could be outfitted and employed as the laboratory. Irving described the laboratory in one of his reports—
"The building now in use as laboratory is a 20' x 40' Quonset hut with

enclosed ends about 3'6" x 20'. While the floor, mounted on 6" x 6" timbers on the gravel, is not steady, the hemispherical walls afford sufficient stability for hanging benches for analytical balances and galvanometers. The building is lighted and provided with 110 and 220 V. A. C. from which normally about 3 Kw are drawn at full load. Heat is furnished by two oil fired stoves and circulation of air by three small fans . . . Propane gas is used for burners and blast lamp. Water is delivered to overhead tanks to supply one sink and distilled water is available from an electric still."

At first, the plan was that the final laboratory would be, eventually, a portion of a 40 by 100-foot quonset-type building—the rest of the building to be used by an arctic test activity of BUDOCKS. This idea was shortly scrapped because of the incompatibility of the two types of activity in a single building. It was felt that the arctic-test work would produce noise, vibration, and fumes that could not be tolerated in the same building as a research laboratory. Also, Doctor Irving, with his special facility for looking ahead, felt that a whole 40 by 100-foot building would be needed soon for what he called "the descriptive natural sciences." He further felt and recommended advance planning for a comparable building for the so-called "physical sciences." All this planning was in conjunction with the OICC in Fairbanks, at that time CDR P. W. Roberts.

As of October 1, 1947, the building for the "descriptive natural sciences," designated Building 250, was complete outside, but it was

occupied as the carpenter shop for Pet. 4. Work was begun on September 30 on the shell of the physical sciences building, Building 251. Doctor Irving, as of October 1, naively planned to move the ARL into Building 250 in two or three months.

Late in 1947, CDR Roberts, with headquarters in Fairbanks, was relieved by CDR George E. Fischer. CDR Fischer, of course, did not have the long background knowledge of the development of the ARL. Also, the Pet 4 operation was becoming larger and much more complex. Therefore, the rather informal working relationships did not carry over fully from Roberts to Fischer, and Doctor Irving was forced to contend with delays and frustrations while having to bend to "go by the book" to a larger extent. Ted C. Mathews, Project Superintendent for ARCON, reported on January 5, 1948, that work was proceeding on interior plans for Building 250 and that the plans would soon be submitted for approval. Thus, Building 251 was still partly in the planning stage at a date long after the date of occupancy as estimated by Irving as late as October, 1947. On January 14, 1948, Irving estimated that Building 251 might cost \$40,000. This figure also was revised, as might have been expected, before the building was complete. Even as late as early February, Doctor Irving seems to have been reasonably content with the situation, even with the delays, for about that time he cheerfully reports advising on plans for wiring, lighting, windows, and drains. And a little later in March, estimated that Building 250 would cost \$121,500 and Building 251 about \$94,500.

In mid-March the OICC had worked out his estimates and informed BUDOCKS that Building 250, complete with internal modifications, would cost about \$90,730 plus 35 percent overhead. This, of course, must have been the source of Irving's estimate of \$121,500. However, for Building 251 he estimated only \$7,000 because "It is not possible to provide an estimate at this time inasmuch as the O in CC is still awaiting a program of requirements for this building."

A little later Irving began to fret over the delays and to worry about whether or not the first building would be ready for the 1948 summer season. He wrote to Doctor Shelesnyak—"The research personnel can be accommodated in #250 as planned if plumbing, wiring, and lights are complete by June 1; windows are installed by June 1; all material for completion is on hand June 1; carpenters and painters can be applied at maximum overtime working speed to the completion of all details by June 7.

"Please note that I shall have to apply my whole technical staff to setting up furniture, tables, shelves and arrangement of laboratory supplies within about 10 days and that we will lose that time and effort from our function of doing research."

By March 31, Irving was downright exasperated. In a long letter to Doctor Shelesnyak was included—"I won't speak further about haste in building our laboratories, assuming you will already have switched the deal from pious expressions of helpfulness from our colleagues to an order that they get the necessary construction fast."

Soon a further complication was added in that it became apparent, and Doctor Irving was officially informed by the ROICC in Barrow, LCDR L. P. Frate, that additional BOQ-type and family-type quarters would have to be constructed for anticipated researchers.

The whole situation up through April, 1948 was summarized in a long letter from Dr. Irving to CNR, RADM Lee. It ended with—"In view of the delay in construction of Bldg. #250, I request that you inform me when Bldg. #250 will be ready for use. If the date of completion is later than June 1, 1948, it will be necessary for me to defer or cancel a number of agreements made to provide research facilities." Also on April 22 at the second meeting of the ARLAB in Washington, the Board was briefed on support operations at the ARL by CDR Fischer, the OICC. Fischer said that construction on Bldgs. 250 and 251 had been suspended because of lack of funds. Doctor Shelesnyak explained that funds had been transferred to BUDOCKS for logistic support and construction. He also informed the group that authority existed for procurement of materials for the buildings. LCDR F. A. F. Cooke of BUDOCKS said it appeared that plans had been presented by the SDARL, that BUDOCKS was not aware of them or did not feel there was sufficient authority proceed with the construction. At this point, the ARLAB unanimously passed two motions—one to the effect that the ARLAB recommended the construction of Buildings 250 and 251, and the other that the Executive Secretary clarify the matter with BUDOCKS and report back to the ARLAB.

The building crisis, at last, was pretty well solved. On June 30, 1948, the SDARL was able to report that barracks buildings 262 and 263 were completed and occupied and that a family-unit building was nearing completion. Laboratory Building 250 was in use, but not finished.

" . . . Temporary sinks and lights have been installed while awaiting arrival of other fixtures. Windows are being installed on the second floor.

"The laboratory building appears well suited for its purpose. Careful consideration of the construction personnel has made possible the use of certain rooms needed by investigators before completion of the building. The progress since authorization to complete on May 17 has been rapid, workmanship has been good and RO in CC, Engineer in Charge and construction personnel have been active in advancing the project in rapid and effective manner."

By the end of August, the drainage system from the building to the beach was finished, windows were all installed, fluorescent lamps and stainless steel sinks were in each laboratory, floor covering of tempered masonite had been laid for a trial, and interior painting had been started on the upper floor. Family unit #6 was completed and occupied.

Construction of an animal house had been started, and Dr. Irving could not resist the opportunity it offered to sputter a little at the delays that had chafed so long and irritatingly. Said he—"It is unfortunate that delay in preparation of plans, estimates and authorization on this simple

structure has occupied some months, while actual construction will require only a few days. The delay has endangered the colony of ground squirrels obtained at great effort, for these animals are now naturally preparing for hibernation.

"As usual, construction is rapid here, and work and services are provided promptly and satisfactorily in every respect. Preparation of plans, obtaining authorization and procurement of materials are slow procedures."

A month later, Irving reported the fate of the ground squirrels just mentioned. "For the ground squirrels a number of outside cages have been filled with wind blown sand in which these animals naturally burrow. A source of sand was found about fifteen miles southwest near the Wiley-Post Monument (he meant the Will Rogers-Wiley Post Monument) and thru the kind and most effective co-operation of Lt. Frank W. Galbraith of Arctic Test some twenty-five tons of this dune sand have been brought in to provide a natural medium for hibernation . . . In spite of the lateness of the season, the squirrels released in these sand filled cages have prepared burrows and it is hoped that they may hibernate normally there within the range of our observation."

Thus, by the end of 1948, the ARL was in fair shape in regard to buildings. Laboratory 250 was complete and in use; old Building 259 was loaned to an Arctic Clothing Unit that needed laboratory space; the animal

house held sea gulls, pigeons, foxes, ground squirrels, and lemmings.

Living quarters 262 and 263 and family-unit 6 were in full use.

Early in January, 1949, the CNR was informed by the SDARL that plans for completion of the construction of the laboratory as well as living quarters were nearly finished. He pointed out that most required materials were at hand, and estimate should very soon be in CNR's hands. The OICC in Fairbanks submitted estimates to BUDOCKS on February 5 for new construction for the ARL as follows —

Two family quarters to be erected by June, 1949, prior to the arrival of the 1949 ship supply expedition, usually in August. Building to be used as BOQ for ARL resident personnel;

One married quarters to be erected by December;

Laboratory building 251 to be completed after the ship expedition;

A 20' by 90' connection between Buildings 250 and 251, to be constructed after the ship expedition.

The OICC went on to point out that in spite of the urgency expressed by the SDARL, materials were in short supply and not much could be done before the ships brought in more materials, except to put up the shell of a 20' by 48' Quonset hut which was available. The OICC was especially upset because the SDARL, with long term needs in mind, was striving for quarters and housing that were supplied to the personnel connected with the oil-exploration program. He told the Chief of BUDOCKS exactly what he

thought should be done about providing superior quarters to the ARL—

"The proposed quarters deviate from the established custom in the Reserve relative to standard bachelor quarters . . . utilized for all personnel regardless of rank or position. Quarters as set forth in Encl (B) involve an expenditure of almost twice that of the revised standard Quonset hut type quarters, . . . Attention is invited to the requirement for maintaining a high level of morale within NPR #4, which it is considered can best be accomplished by adherence to standard type quarters for all personnel, as has been practised in the past and proven successful to date. Furthermore, the provision of quarters for men of varying amenities will only complicate the present system of accounting . . . Also, if ONR has any married personnel, attention should be invited to the fact that married personnel are not allowed occupancy in the barracks area for men and are restricted to the area designated for married employee's housing. Since the Scientific Director, Arctic Research Laboratory, at the present time is not within NPR #4, it is requested the Bureau of Yards and Docks discuss the proposed ARL housing with representatives of the Office of Naval Research and strongly recommend erection of standard type bachelor quarters . . ."

Near the end of March, the OICC further informed ONR directly that additional funds for all construction estimated in calendar 1949 should be transferred to BUDOCKS immediately in order to make possible

procurement of materials in the States and their transportation to an embarkation point for the ship expedition by May 15.

A paper appears in the files of ONR headed "Recommendations for Expansion of the Arctic Research Laboratory." It is undated and unsigned, but from its context, it was prepared in ONR and must have appeared in, perhaps, April or May, 1949. It is a thoughtful dissertation, in considerable detail, on building requirements and other matters of concern to the ARL. In regard to buildings, it recommends—that Building 251 be completed as a laboratory building; that it contain a garage for weasels; and that the second deck be fitted out as a dormitory for forty men. The paper goes on to recommend a quonset-type connection between Buildings 250 and 251 to be used as a shop, and a 20' by 48' Quonset hut behind Building 251 to be used as comfortable quarters for year-round personnel.

The above-mentioned paper appears to be the reference point of a memorandum dated June 8, 1949, from the CNR to the Chief of BUDOCKS that summarizes ONR's estimated building needs for fiscal 1950. It confirms the need for a connection for a shop between Buildings 250 and 251. It confirms the need for two MOQ-type quarters—one to be completed before the 1949 ship expedition. It points out that a delay of a year in the completion of Building 251 will not be detrimental to the program of ONR and that, therefore, Building 251 can, for the time being, continue to be used as a recreation building by the oil-exploration program.

New programs must be generated

As has been pointed out, the ARL, from the start, was conceived as a national facility. The idea is fine, and the position one of which to be proud—but how are these programs, both in-house programs and guest programs, generated. As might be expected, the responsibility for insuring a strong, broad program fell in part on the sponsoring organization, ONR, mostly Dr. Shelesnyak, and especially on the SDARL, who had to spend a great deal of time and energy in efforts to stimulate projects of ever-increasing breadth and scope. Both Doctors Shelesnyak and Irving wrote for Navy publications, Science, Arctic, and other media about the ARL and the opportunities there. The response was swift and strong as word of the ARL began to get around among scientists. Irving and Shelesnyak attended meetings of scientific societies and other groups and passed the word orally.

The ONR worked closely with the Arctic Institute of North America, a main objective of which was the encouragement and sponsorship of arctic research projects. Furthermore, after it was established in March, 1948, the Advisory Board was helpful in generating programs. But, in addition to such rather general efforts, Irving took on the task of personally visiting universities and talking to scientists he thought might have an interest in the program and hopefully might wish to participate.

Doctor Irving kept pressing continually for ONR attention to the future program of the ARL. In August of 1947, only a few days after arriving at

Barrow, he wrote to Doctor Shelesnyak urging that he talk to Doctor Waterman about a "far-sighted program." In letter after letter he speculated about a long-range, broad program. For instance, on August 18, 1947, he said, the ". . . support provided for the Swarthmore-ONR group indicates that an effective center for field investigation of Arctic scientific problems is already established. If well supported by scientists at home, the station will facilitate the steady acquisition of the scientific knowledge of the Arctic environment which is necessary for productive occupation of the Arctic regions. It can also open a field of educational experience for our young men in which they will derive inspiration from facing the unique conditions existing in the Arctic frontiers of America.

"Since we have been authorized and supported in working in these stages of arctic research, I believe that we are thereby obligated not only to complete our immediate projects but to give such thought as we can to plans which will assure the continued production of good research in the most efficient and useful manner possible."

Even before the Irving party first went to Barrow in August, 1947, months before, contacts about potential investigators had been made by ONR representatives and by Irving with many institutions including Cornell University, two departments at the University of Chicago, Woods Hole and Scripps oceanographic institutions, Fordham University, Dartmouth College, Bowdoin College, University of Colorado, and others. Such contacts

were intensified and multiplied after research actually started at Barrow. In a trip to the States late in 1947, Doctor Irving reported calling at the American Museum in New York, Harvard University, University of Chicago, University of California in Los Angeles, the California Institute of Technology, Scripps Institution of Oceanography, the University of Washington, and the University of Alaska. He talked to several people at each place. Contacts also had been made with the University of California, Stanford University, University of Pennsylvania, the Arctic Institute of North America, the University of Illinois, University of Denver, and the George Washington University.

Doctor Irving soon discovered that it was difficult to persuade research scientists to commit themselves to long intervals of arctic research. Apparently, he began to speculate on how a strong continuing arctic research program could be assured, and this seems to have been the beginning of his visualization of what he called "expeditionary physiology". By January, 1948, he was writing to Doctor Shelesnyak to propound his developing thoughts—"It seems to me most realistic to recognize that the present personnel and research plans come to the ARL from a proposition for expeditionary physiology. I do not know of any scientists who will commit themselves to prolonged programs of exclusive arctic research, nor does any institution in the U. S. yet outline lasting opportunities, let alone programs or terms of employment for arctic research.

"When arctic research presents careers or employment on enduring terms will be time to consider prolonged arrangements. At present it has been fortunate that expeditionary physiology could provide the main operating force and that its members have been willing to work toward a long term development while having themselves no assurance of lasting occupation or relation to the project. I think these definitions fit all of us and I cannot think of any useful promise unless we recognize the practical situation in which we work."

Doctor Irving also spent a great deal of time through correspondence and personal visits in following up the numbers of contacts that he developed. He brought a number of these contacts to the actual project stage and those became part of the ARL's total research effort. Furthermore, he continually developed new contacts. The general success of his efforts is illustrated by noting that as of August 31, 1948, the progress report of the SDA L lists as underway programs under the auspices of Swarthmore College, Cornell University, the Naval Ordnance Laboratory, the Arctic Institute of North America, the University of Minnesota, the California Institute of Technology, and Stanford University. But Irving was still concerned about the adequacy of the program and even in transmitting the report just mentioned to the Chief of Naval Research, he said "After one year of operation of the Arctic Research Laboratory, it is desirable that the most thorough and critical study of its activities be made in order to

strengthen the program which should be presented for your approval for the following year. "

Doctor Irving, by the fall of 1948, also was becoming more and more concerned about the difficulty of broadening the program to include more projects in the physical sciences. He observed that he thought the requirements for research are greater than he previously thought, and that the facilities and natural situation are better than he expected. Nevertheless, he said he was unable to examine extension into new fields and saw no means of expanding the program into the physical sciences as earlier had been contemplated.

By late September, it appears that Doctor Irving was so fed up with administrative problems and frustrations, that he proposed to spend most of the rest of his time in pursuit of his own research and pass back to ONR any concern about programs for the future. A discouraged letter to Doctor Shelesnyak, dated September 23, set forth his reactions in some detail. However, only two days later he submitted a carefully planned, detailed proposal for a survey of the fauna and flora of the Alaskan arctic slope to be carried out by a team of four researchers in the summer of 1949.

As of early January, 1949, the SDARL was still concerned with the problem of programming. On January 4 a letter of the ONR contained "The establishment of continuing research programs at the Arctic Research Laboratory . . . appears to need early attention . . ." And, later in the

same letter "I believe I can continue to keep a strong center of investigators . . . and make arrangements for the recruitment of junior investigators to replace a normal turnover, but the preparation of a program is linked with the physical and academic facilities available. These matters I cannot determine from here, and yet upon their definitions rests the future participation of our present staff in expeditionary research and probably the continuation of the operations of the Arctic Research Laboratory."

Finally, as has been earlier mentioned, the research program of the ARL in total constituted only a part of the research effort that was going on in or adjacent to northern Alaska and that was supported logistically by the Pet 4 operation. The history of the oil exploration mentions that in 1948 support was given to the Arctic Test Station of BUDOCKS, to a project of the Army Corps of Engineers in permafrost studies, to ice-thickness measurements by the Radio Corporation of America, to insect studies by the National Medical Research Institute, and to geodesy and magnetics by the Coast and Geodetic Survey. Further, the oil-exploration program itself included research in several aspects of geology and geophysics. Other projects, not specifically designated, were supported also.

GEORGE MACGINITIE BRINGS GROWTH AND PROGRESS

On July 1, 1949 Doctor George MacGinitie became the Scientific Director of the Laboratory. Doctor Irving had launched the Laboratory and started the research. Doctor MacGinitie therefore inherited a going concern but one which nevertheless required substantial modification. Under the new SDARL, who for reasons of health remained in the saddle for only about 14 months, the research program was broadened and strengthened, the laboratory was expanded and otherwise improved, and administration and procedures were modified to meet changing conditions.

Doctor MacGinitie, having already carried on research at the ARL, knew a good deal about the responsibilities he was shouldering. Full of sparkling wit, uncommonly handy in performing all sorts of manual tasks, an accomplished sailor, and a kindly and courtly gentleman, he soon won the affection and the whole-hearted cooperation of those with whom he dealt — the oil-exploration contractor, the representatives in Alaska of BUDOCKS, visitors, ARL employees, Eskimos and outsiders alike, and researchers. Nevertheless he knew how he wanted the ARL to be run — and he ran it that way. He could be firm in administration — and frequently was — until the ARL was going as he thought it should. He and his well-loved wife, who was with him as an assistant, were just what the ARL needed at the time he appeared. Furthermore, in addition to administering the ARL, Doctor and Mrs. MacGinitie contributed immensely through their own research program.

A Broad Research Program

Dr. MacGinitie turned out a 4-page Newsletter less than two weeks after his arrival at the ARL and his assumption of the responsibilities of SDARL. In that report he said that at the ARL when he arrived were Dr. G. R. MacCarthy of the Geological Survey; Dr. Neal Weber, Arctic Institute of North America; Dr. Charles Bates, Hydrographic Office; Lloyd Spetzman, Arctic Institute of North America; William Schmieder, U.S. Coast and Geodetic Survey; and R. Nelson, Fish and Wildlife Service. He said that by the end of the summer thirty-two people will have been provided space in the laboratory in a professional capacity. He also added a typical MacGinitie comment that "Dr. MacCarthy went to Oumalik Saturday to install thermocouples at the drill rig for the Contractors, who are quite pleased that scientists can be useful as well as ornamental nuisances."

In a Progress Report dated August 31 the SDARL reported on most of the research projects during the summer of 1949. Most of the following review of that summer's program comes from that report plus a little fill in from correspondence files and other sources. The review is intended to summarize the work underway, its status, and future potential. It also can be compared with the program of the previous year to indicate progress and expansion of the research effort.

In regard to his own research project, the SDARL reported a busy and successful summer. Information was filled in on the abundance and

distribution of marine invertebrates of the region. It was found that the fauna does not vary greatly at depths below about 100 feet. Of interest is the mention of a submarine canyon 12 miles offshore in which the canyon bottom, about one-quarter mile wide and muddy and covered with worm tubes, lies at a depth of more than 700 feet between depths on either side of between 400 feet and 500 feet.

The formal Progress Report although informative contains little of MacGinitie's observations and reflections — it is necessary to look a little deeper in correspondence and other records. One can almost hear MacGinitie chuckle as he reports — ". . . the surf is worse than ever this morning, although the wind is not very bad. Hundreds of Echinus have been washed ashore and are still coming. This indicates that the bottom is churned up for several inches. Chester Lampe (one of the Eskimo assistants) says the natives, especially the older ones, eat these worms when they are washed ashore. They cut off the 'head' end, pull out the insides and eat the remainder raw. They must be tough as whale muktuk (whale skin greatly prized by the Eskimos as a delicacy). But what they call the 'head' is really the posterior end with its double row of bristles around the anal opening. They evidently assumed that the proboscis was a 'tail.'"

Mr. Hamilton of MacGinitie's project concerned himself with the study of mammals and birds.

Dr. Neal Weber of Swarthmore College and working under an Arctic Institute grant collected insects in the region from late June until early August. He collected at Umiat, a sub-base of the oil-exploration program on the Colville River; at the Anaktuvuk Pass; at two of the Pet 4 drilling sites — Omalik and Fish Creek — and near the ARL.

Vladimir Walters, also of Swarthmore, but working on the old Swarthmore contract of the previous SDARL, returned to the ARL for a little more than a month to collect fresh-water fish at the Anaktuvuk Pass; Umiat; the small Eskimo camp or settlement called Half Moon Three; and near the ARL. There was a little stir about Walters' returning as the visit had not been called to the attention of the SDARL in advance. However at the expense of a few wires the short visit was authorized by the Director of Naval Petroleum Reserves.

Dr. George Llano of the Smithsonian Institution, but supported by a grant-in-aid from the Arctic Institute, worked in northern Alaska for about two months. He was making a survey of cryptogamic plants with emphasis on the lichens. He studied in the Wainwright vicinity, in the mountains around Anaktuvuk Pass, in the upland tundra and Colville River valley near Umiat, around Point Barrow, and at Half Moon Three.

Permafrost investigations were continued by Dr. MacCarthy assisted by Mrs. MacCarthy. Their work consisted of several parts. A resistivity profile was determined to study the thawing effects of a lagoon near the ARL. Resistivity studies were made also of the effects of seasonal change.

A thermoprobe was made inland from Elson Lagoon by using seismic shot-holes made by an oil-exploration geophysical party. The shot-holes also provided the means to investigate the return to thermal equilibrium after a seismic shot. Other studies were made by the use of thermistor cables in widely spaced seismic shot-holes and oil-exploration drill holes. A cable was placed in gas well South Barrow 3 when it was abandoned. The cable extended to 1500 feet — clear through the permafrost.

After substantial planning Dr. John R. Paul, Director of the Commission on Virus and Rickettsial Diseases and under contract to the Army Epidemiological Board visited the ARL late in the summer to collect blood samples of the Eskimos. In mid-September after returning to New Haven, Connecticut, he wrote Dr. Shelesnyak to say that his research had been highly successful and that he had about 250 samples of Eskimo sera representing a wide distribution of age groups.

From the St. Louis University came Dr. X. J. Musacchia with Doctors L. A. Susca and B. J. Sullivan. They were supported by an AINA grant. Because of travel difficulties they were late in arriving at the ARL and hence were there only from July 12 to August 16. Nevertheless they made good progress in their research on lipids and fats of arctic animals, including mammals and marine invertebrates. Other researchers assisted them by collecting material on which they could work.

Dr. Weidar Wennesland and Klaus Odenheimer from Stanford University began work in July in designing and perfecting equipment for study

of the respiratory rates of fish. They were joined for two weeks in August by Dr. J. M. Crisman, also of Stanford. Also in mid-August they were joined by Dr. Gabor Markus. Some test runs were made on arctic sculpin and capelin and aquariums were prepared for work on arctic cod when they returned with the ice.

Lloyd Spetaman, under an AINA grant, made botanical studies and collections at several places in northern Alaska including Anaktuvuk Pass, Half Moon Three, and near Barrow. He returned to the States on August 16.

Space was provided in the ARL for use by some investigators whose work was not part of the official ARL program. One of these was Mr. R. Nelson of the Fish and Wildlife Service who was at the Laboratory for only a few days. Another was Mr. William Schmieder who was making geophysical observations for the Coast and Geodetic Survey.

In June 1949 the Amphibious Branch, ONR, requested an opportunity to work out of the ARL later in the summer on certain beach accessibility and trafficability matters. The project was designed to provide research to establish keys for interpretation of soil and beach conditions from photographs. The overall project, of which the part to be carried out at the ARL was only a small part, had been given a high priority by the Chief of Naval Research.

The ARL part, which was carried out under contract with Cornell University, was done by Professor Taylor D. Lewis and Harmer A.

Weeden. They arrived at the ARL on August 18 and departed on September 3. They accomplished more than they had expected by full use of weasels, boats, and aircraft. Shortly after their arrival they went through one of the experiences not uncommon among workers in northern Alaska. The incident is described in the Newsletter of the ARL for August. "Professor Lewis and Mr. Weeden were taken down the coast today (20 August) in a bush plane and set down on the beach twelve air miles east of Simpson Seeps (but over 20 miles by weasel). The pilot was to continue on to Simpson and return for them four hours later. But a call for some gasoline had come in from some out-lying party and had to be delivered. Upon the pilot's return he had another call for some repair parts to be delivered, and by the time he returned from that mission the fog had closed in so badly it was impossible to go for the men. They were left on the beach at 11:00 a.m. Saturday and were picked up by weasels sent out from Simpson the following day. The weasel got them back to food and shelter by 9:30 p.m. Sunday, with some practical knowledge of trafficability in the Arctic. The weasels made a round trip of 57 miles."

For some time concern had been increasing over the adequacy of the oceanographic program in which several organizations alternated every few months in staffing the work. The organizations included the Hydrographic Office, the Woods Hole Oceanographic Institution, and the Scripps Institution of Oceanography. At the May 1949 meeting of the ARLAB, the Board had concurred in a report that short periods of research were expensive and relatively unproductive. That report stated also that, "It is regretable

that present oceanographic work has largely been confined to studies of the shelf, when so little is known about the Arctic Ocean."

When Dr. MacGinitie took over on July 1 the oceanographic program was being carried on by Dr. Charles Bates. His special interest was sea ice. For a few days in July tundra and beach conditions were reviewed by a group consisting of Dr. Beauregard Perkins of ONR, B. Trawicky of the Permafrost Division of the Corps of Engineers, and R. E. Frost, J. R. Shepard, and O. W. Mintzer of Purdue University.

J. B. Wickham and Gordon Groves of the Scripps Institution of Oceanography reached ARL late in August and began their investigations of ocean currents and sea-atmosphere relationships.

Dr. Bates left on August 9. While at ARL he had investigated the thickness of ice floes, had made a profile of ice salinity from the beach out to the first pressure ridge, had made aerial observations of ice conditions between Point Lay and Barter Island, and had tested seismic methods of obtaining water depths in shallow water. He also had discussed with the Army, Navy, and Air Force in Alaska their special interests in arctic oceanography.

Dr. Dan Campbell of the California Institute of Technology, assisted by Frank Talbert, arrived at the ARL on August 9 and left on August 27. He was concerned with immunological and biochemical studies of arctic animals especially as related to hibernation. He had intended to work on ground squirrels but the Laboratory was unable to obtain a supply. He

therefore used lemmings. A week after Campbell left, 25 squirrels were obtained.

The SDARL was grateful to Dr. Campbell for his help in inventorying the supply of chemicals at the Laboratory and to Frank Talbert for assisting in plant management.

Owen Rye from the University of Alaska reached the ARL on July 5 and pursued his studies of archeology and dendrochronology until returning to Fairbanks on September 22. He excavated in several old village sites and collected driftwood from Point Barrow to Skull Cliff. The oceanography group of ARLAB was especially interested in one aspect of his work — the study of ocean currents from the distribution of driftwood. In early September Mr. Rye gave a seminar at the ARL which the SDARL happily reported by saying, ". . . out of courtesy to the laymen who attended our meetings, he entitled 'Tree Rings and Eskimos' instead of 'Archeology and Dendrochronology.'"

Parasites of arctic animals were investigated by Dr. Robert Rausch of the U.S. Public Health Service. He arrived on July 7 and carried on his studies until October 8. Rausch found *Trichinella* fairly common in most of the mammals. He reported finding *Trichina* in the blue whale. During the summer he made a collection of mammals from the Anaktuvuk Pass area. In addition to effectively carrying on his own research, Dr. Rausch was helpful in many ways. For example in July he administered medicine to the natives at Anaktuvuk Pass to check a serious outbreak of

dysentery among them. In September Rausch went to Anaktuvuk Pass with food for a week. The SDARL reports, "The second day he was there he gave all his food to the natives and ate with them thereafter. They lived almost exclusively on caribou meat, usually eating it raw, but sometimes cooked."

The preceding pages outline the scientific program during the summer and early fall of 1949. The reader will note that the ARL provided support to a number of projects that were not part of its regular program. This most commendable practice has been characteristic of the ARL from the start and still is going on. In the summer of 1949 such extra-curricular projects included but were not limited to those of the Hydrographic Office, the Public Health Service, the Corps of Engineers, and the Coast and Geodetic Survey.

From about September 1 on the program consisted of the continuation of some of the going projects and the addition from time to time of new projects. Some of these will be mentioned below. Also the SDARL, like his predecessor, was concerned with the development of programs that might be initiated in the more distant future.

Dr. Robert F. Black of the Geological Survey and his assistant Mrs. Hernelda L. Black reached the ARL on September 6 to begin investigations of ground ice and other aspects of permafrost. His project involved contraction studies in selected areas of different geologic environments, the collection and interpolation of ice samples, especially

ground ice, and microscopic studies of ice in a cold room. His work included snow studies in an attempt to correlate snow cover to growth of ground ice.

Dr. Ira Wiggins arrived on September 3 from Stanford University in order to survey the region with a view to proposing a botanical project in 1950. Dr. MacGinitie had known Wiggins for many years and recommended him highly. It was of course completely unanticipated that within a year Wiggins would follow MacGinitie as SDARL. Dr. Wiggins left the ARL on September 13.

On October 1 L. D. Hoadley and D. M. Owen from the Woods Hole Oceanographic Institution reached Barrow to begin a project in ice oceanography. Among other activities they set up several stations north of the ARL to beyond Point Barrow to take temperatures, current readings, and water samples. The team started back for Woods Hole on November 29. They had been handicapped seriously because of the non-arrival of needed special equipment. Furthermore certain offshore current studies and pack-ice studies were impossible because the ice pack had not yet grounded. Despite their difficulties the pair completed a commendable project.

The project of Dr. Wennesland of Stanford University on the tissue metabolism of arctic cod, previously mentioned, terminated on December 15 when the investigators departed. The project had been handicapped badly by the failure of the ice pack to ground. The cod apparently move with the ice and cod were not available. A good deal of progress was made in development and production of equipment such as microrespirometers.

A two-man team from the Naval Ordnance Laboratory (NOL) began a program in early November on time variations of the earth's magnetic field. The team consisted of A. M. Levine and S. J. Raff. Difficulty and delay were experienced in the receipt of equipment and some methods had to be improvised. A wanigan was equipped with instruments and towed to a site on a lake north of the ARL. A generator was installed and a coil frozen into the lake. By the end of the year recordings had been made for twenty-one continuous days. Data were collected on the character of polar magnetic storms.

Finally, on December 23, R. N. Rowray of the Naval Electronics Laboratory (NEL) reached the ARL to begin his second tour of duty there. The project was titled Snow Insulation and its Effect on Sea Ice Growth. In the few days before the end of the year Rowray had made a brief review of sea-ice conditions since the previous July, including the movement of ice grounded on the shore on December 26 and 27.

Thus at the end of 1949 the following projects were underway at the ARL —

1. Time variations of the earth's magnetic field — NOL
2. Distribution and ecology of arctic marine organisms — The Johns Hopkins University
3. Permafrost investigations — U.S. Geological Survey
4. Snow insulation and its effect on sea ice growth — NEL

5. Investigation of ground ice — U.S. Geological Survey

6. Tissue metabolism of arctic cod — Stanford University.

A new year was starting, a balanced program was being pursued energetically, morale was high, and the ARL looked forward to 1950 with confidence and enthusiasm. And so the research program went on throughout the long, dark winter. A few researchers came, and a few left, as required by their projects. On January 10 George S. Scholl and William E. Austin arrived to relieve Raff and Levine in the magnetic project of the NOL. The latter two departed on January 14 and 26 respectively. Another NOL project was started on January 19 by Homer N. Opland. It was titled Hydrophone Studies under Sea Ice and involved underwater sound investigations. Mr. and Mrs. Jacob Wickham returned to Barrow in mid-February to renew the project of the Scripps Institution of Oceanography in sea surface-atmosphere relations.

Between March 12 and 15 Dr. Xavier Musacchia and J. G. Gleason were at the ARL working on hibernating ground squirrels. Tissues were preserved for future analyses and some blood serum was sent to Dr. Campbell at Pasadena. On April 6 John F. Holmes came in from the Woods Hole Oceanographic Institution and in a few days went on to Barter Island. Dr. Wennesland returned on May 16 to complete work on the arctic cod. On May 23 Mr. Kowray completed his work on snow insulation and its effect on sea ice growth and departed and on May 29 Dr. Rausch again returned to Barrow for about two weeks.

The SDARL submitted a written report to the ARLAB when it met on May 31, 1950. He was unable to attend in person because it was the rush season at the ARL and alterations were in progress in one of the main ARL buildings. His report outlined the program planned for the summer season just starting. In regard to the going program he said — "I believe that excellent work has been carried on here at the laboratory by the different research workers. All of this has been reported in our monthly progress reports. The oceanographic program still leaves something to be desired."

The June progress report described the following projects underway —

1. Investigation of ground ice — U.S. Geological Survey. R. F. Black and Hernelda L. Black
2. Distribution and ecology of arctic marine organisms — The Johns Hopkins University. G. W. MacGinitie, Nettie MacGinitie, H. M. Feder, and Marian Pettibone (with the U.S. National Museum)
3. Permafrost investigations — U.S. Geological Survey. G. R. MacCarthy and Elizabeth E. MacCarthy
4. Oceanographic currents, sea surface-atmospheric relations — Scripps Institution of Oceanography. J. B. Wickham and Janet W. Wickham

5. Studies of the earth's magnetic field — U.S. Naval Ordnance Laboratory. G. S. Scholl and W. E. Austin
6. Biological studies of vertebrates and invertebrates of the arctic slope — St. Louis University. X. J. Musacchia and E. V. Orsi
7. Ecological and taxonomic investigation of the vascular plants in the vicinity of Point Barrow — Stanford University. I. L. Wiggins, H. J. Thompson, and J. H. Thomas
8. Metabolism of arctic animals — Boston College. B. J. Sullivan and Joseph Mullen
9. Tissue metabolism of arctic cod adapted to various levels of temperature — Stanford University. Reidar Wennesland

All of the above projects still were going on at the end of July. In addition two new projects had been started. The first was on the taxonomy and ecology of recent arctic foraminifera. The investigator was Dr. A. R. Loeblich of the U.S. National Museum. Dr. Loeblich recovered foraminifera from bottom samples. Within two weeks he had identified about eighty species. The second was a project of D. Q. Thompson of the Johns Hopkins University on the life history and ecology of the lemming.

The July Progress Report was the last made by Dr. MacGinitie as SDARL. By the end of August he had been relieved by Dr. Ira L. Wiggins.

Administration by the ONR

Dr. MacGinitie took over the ARL on July 1, 1949 just at a time when other changes were being made or planned in the administrative organization to which the ARL reported. Dr. Shelesnyak, to whom the SDARL was directly responsible, was about to be relieved by Dr. John Field as Head, Ecology Branch, Earth Sciences Division of ONR. The contract for the operation of the ARL was being terminated with Swarthmore College, although an extension of several months was arranged so that the Swarthmore scientists might complete their reports, and a new contract for ARL operation was being negotiated with the Johns Hopkins University. In spite of those complications the transition was surprisingly smooth and effective. In the first place the principals operated in an environment of mutual trust and respect. Secondly Dr. MacGinitie was a man of uncommon patience and understanding. Thirdly, but by no means least, Mrs. Yvonne Reamy was by that time the Administrative Assistant for ARLAB and actually handled much of the business. She knew and understood the various elements in the operation, she referred the questions and problems of the SDARL to the proper places, and then she rode herd to make sure that prompt and substantive answers went back. As an expeditor and as an information center she was most effective.

Mrs. Reamy's value was soon recognized by the new SDARL for as early as July 11 one of his long business letters to her contained the following —

"Perhaps you could find someone around there who might be interested in coming up for a year. I just asked Nettie (Mrs. MacGinitie) if I could commit bigamy and marry you and bring you up here. She doesn't raise any great objections."

One of the first matters that required attention was the final negotiation and signing of the new contract with the Johns Hopkins University. This involved waiting for the passage by the Congress of the Navy Appropriation Act and took a matter of several weeks during which time the University operated on the basis of assurance from ONR that in due course the contract would be signed and that it would be effective as of July 1, 1949. Technically there was only an informal basis of operation for some time and this of course applied to the personnel at the ARL, including the Scientific Director, who technically was not the SDARL until the contract was signed, and who was transferring his staff relationship from the University of California to the Johns Hopkins University. His letter of appointment was not signed until September 12.

Another problem was that of the proposed transfer of the former Plant Manager at the ARL to the Johns Hopkins contract. The individual had been brought out from Barrow to Swarthmore by Irving to assist in some of the activities involved in closing out the Swarthmore contract — principally property records. At first it was thought that he would return to Barrow and continue in the same position under the new SDARL and under the new contract. After a long and involved hassle over salary to

be received and amount of leave due, the man was separated and did not return. However all the negotiation caused an incredible amount of correspondence and used an incredible amount of time of many individuals at the ARL, in ONR, at Swarthmore, and at Johns Hopkins.

Still another matter that was accomplished by ONR in the early part of Dr. MacGinitie's administration was the rescinding of the earlier action that had designated the ARL a naval activity to be under an Officer-in-Charge. On the advice of the ARLAB and in view of the anticipated Johns Hopkins contract it was felt that "the research work being conducted at subject laboratory can best be coordinated under the direction of a university research contractor." On August 4 the Secretary of the Navy, Francis P. Matthews, took the recommended action.

Captain C. W. Shilling, Deputy for Bio Sciences, ONR, wrote the Committee on Medical Sciences of the Research and Development Board of the Department of Defense on August 25 concerning a proposal to expand the Aeromedical Laboratory of the Air Force at Ladd Field (now Fort Jonathan Wainwright), Alaska. Captain Shilling, while not objecting to the plan of the Air Force, pointed out some of the advantages to be gained through the use of the ARL and including the good possibility of joint support of projects of common interest.

As might be expected there was a good deal of confusion in the transfer of accountability of property from one contractor to the other. Some items had disappeared, some were found to be broken, some apparently

had been shipped back to Swarthmore, and some seemed to have gone with various researchers to other institutions. There was a good deal of correspondence on these matters throughout July, August, and September but by October most of the details appeared to be pretty well settled. Paul Kratz, the Resident Representative of ONR in Philadelphia and the SDARL at Barrow were especially energetic in clearing up the records. This was necessary in order that JHU would have some confidence that items for which it was assuming responsibility were really under its control.

However, the subject did come up once or twice later but was soon resolved. In a long letter dated May 29, 1950 a representative of The Johns Hopkins University reported to the ONR the University's concern over the accountability for property as handed over from Swarthmore. Swarthmore's responsibility was cleared apparently by a memorandum dated June 30, 1950 from Paul Kratz to ONR that stated — "Thus, after this shipment, Swarthmore College was clear of any equipment."

Another matter that required a good deal of negotiation in the fall of 1949 was the termination of the Swarthmore contract. It had been extended until August 31, 1949 in order to allow Dr. Irving and his associates to complete their reports. It became apparent that as of that date about \$7,000 of contract funds would remain unspent. Dr. Irving requested that those funds be used for defraying publication costs of the reports that were to be ready. Dr. Field in ONR took the position that "there are appropriate journals for publication of the several studies carried out at the ARL . . .

"Publication in such journals does not entail any expense to the authors excepting the costs of reprints. While some advantage in economy of bulk and effort might be obtained by publication of this work in one volume, it is considered that the information would enjoy a much wider circulation if published in the usual professional journals."

In a long telephone conversation on September 12 between Dr. Field and President John Nason of Swarthmore it was decided that the contract had in fact expired on August 31 twelve days before the conversation, that the \$7,000 would remain unspent, and that no further contractual arrangement would be made.

Financial matters were handled much as in the past except that they were somewhat easier because of more experience. On August 30 the ONR advised the Chief BUDOCKS of some estimates for the ARL as follows:

From July 1, '49 through December 31, '49:

Logistic support including housing and messing, materials
and supplies, shop work, engineering assistance,
arctic gear, equipment use, and transportation of
personnel _____ \$ 36,650

From July 1, '49 through June 30, '50:

Air support, including overhead _____ \$ 42,000
Modification of buildings
Married quarters _____ \$ 13,610

Connection between Bldg. 250 and Bldg. 251 _____ 7,740

At least twice before the end of calendar 1949, once on September 13 and once on November 7 ONR warned the SDARL of the need for economy because of limited available funds. In the later memorandum he was urged to cut costs so far as possible of logistic support and airlift.

On December 21 the OICC supplied the SDARL with air-support cost for calendar 1949 through November 30 as follows:

Freight, including indirect cost _____	\$ 4,320
Transportation of persons _____	9,175
Bush flying, including indirect cost _____	<u>4,770</u>
Total	\$ 18,265

Similarly the cost of logistic support through November 13 was, including indirect cost, \$100,017.

Also supplied in December were some figures for the cost of logistic support for one man for one year at the ARL. The derivation of the cost is interesting:

Contractor's charge (subsistence and lodging) _____	\$ 2,100
Travel (1 round trip, Fairbanks to Barrow) _____	196
Prorated Laboratory charges _____	7,637
Arctic clothing _____	<u>250</u>
Total	\$ 10,183

In two memoranda dated January 28, 1950 and January 30 respectively the OICC of the Pet 4 project informed the SDARL of his record of the cost

of ARL support for essentially all of calendar 1949 and for all of 1948. The memoranda showed:

Cost of air support, 1948	\$ 24,500 (rounded)
Cost of air support, 1949	18,500 (rounded)
Cost of other operations, 1947	26,000 (rounded)
Cost of other operations, 1948	174,800 (rounded)
Cost of other operations, 1949	109,000 (rounded).

The "other operations" included such items as messing and billeting, materials and supplies, shopwork, arctic gear and clothing, some building costs, and maintenance of buildings.

On March 1 the OICC informed the Chief, BUDOCKS that the SDARL estimated that \$100,000 would be required to support the ARL in calendar 1950. The OICC indicated that of that amount \$60,000 would be needed through June 30 and the remainder in the new fiscal year.

As of mid-March the record of the OICC showed obligations for operations in 1950 at about \$11,000 and of air support at about \$1,250. As of May 2 the SDARL was informed by ONR that "As indicated previously, we recently put in an additional \$20,000 to the logistics contract . . . The twenty thousand dollars should be sufficient to cover the interim between 1 July and whenever we get the monthly statement of expenditures.

"As soon as the monthly statement of expenditures for 30 June is received, we can arrive at a balance and will know just how much it will be necessary to put into Project 18 for both airlift and logistics."

An internal ONR memorandum dated June 15 pointed out that "As of 14 May 1950, there is a balance in the . . . contract of \$89,908. Subtracting the \$29,000 of this to be used for conversion of #251, we have a balance of \$60,908, to be used solely for logistic support. This will amply cover through 31 December 1950. From January to 30 June 1951, approximately \$50,000 will be needed. Of this it may be possible to again secure NOL support in an amount of \$30,000."

It had long been planned that at an appropriate time, generally considered to be early spring of 1950, the ARL would take over and modify for its own use Building 251, a quonset-shaped structure the same size as the first large laboratory building and adjacent to it. Some confusion arose however because that building was being used as a gymnasium by ARCON. As of September 1, 1949 the SDARL confirmed the ARL's need for Building 251 and not later than April 1, 1950. He said in a letter to Dr. Field — "Building 251 would certainly enhance our facilities. This summer summer of 1949/ we were fortunate in having certain people leave before others arrived, so that while all laboratory space . . . was used, in only one room did we have to put two parties with different activities. With an allotment of thirty-one people and the uncertainty of the elaborateness of particular activities, I believe that we would take quite a chance to defer the use of Building 251 beyond April 1950.

"Therefore it is my recommendation that Building 251 be requested for use by the ARL beginning April 1, 1950. It will take us a month or

six weeks to get it ready for occupancy by summer investigators, and still make use of it for the summer of 1950. Also, by using the upstairs of 251 as a dormitory we can turn back to the Contractors 259, 262, and 263."

On receipt of the SDARL's recommendations, Dr. Field requested him to estimate the cost of preparing Building 251 on two bases -- fitting out the first floor only as laboratory space and fitting out the first floor as laboratory and the second floor as a dormitory.

The SDARL promptly replied that by making certain economies such as heating by gas stoves instead of installing expensive ducts, doing a good deal of the work with ARL employees, and less elaborate plumbing installations, and because of certain savings in other activities, he felt that the whole job could be done with current-year funds already allotted to the ARL.

By November 22 the estimates for Building 251 were ready and they aggregated approximately:

For materials _____	\$ 10,500
For labor _____	16,000
Indirect cost _____	10,500
Contingency _____	<u>5,500</u>
Total (rounded)	\$ 42,500

The OICC of the oil-exploration program on November 22 confirmed this by estimating the total cost of modifying Building 251 at about \$43,000 and so informed the SDARL.

One would have expected conversion to start then without delay, but such was not the case. An inexplicable and baffling series of delays followed that will not be set forth in detail. About mid-February consideration was given to calling the work "alteration" instead of "conversion" in order to fit better Navy practices and appropriate language. Also suggestions were made about the trade-in value of Buildings 259, 262, and 263 that were available to go back to the Pet 4 operation and it was hoped that the turn-in value could be credited to the "conversion" or "alteration" of Building 261. It was thought that perhaps the floor of the second deck in 261 could be traded for the other buildings. Through all this the SDARL repeatedly reported the help and cooperation given by Commander M. H. Aubey, the OICC in Fairbanks for the Pet 4 work and of the ROICC in Barrow and Jack Adams, the superintendent in Barrow for the Pet 4 contractor, ARCON.

Repeated attempts were made to find needed funds from unspent and unencumbered resources in the Johns Hopkins contract and in the funds transferred by ONR to BUDOCKS. Then about mid-March an effort was made to arrange an outright gift from the Director of Naval Petroleum Reserves, Commodore W. G. Greenman, to ONR. This triggered a discussion of who owned Building 251 anyway -- the DNPR, BUDOCKS, ARCON, or who. Then details were requested of materials cost and availability. Several times arrangements seemed on the point of being completed -- only to encounter another hurdle. ONR had to make another formal request. BUDOCKS wanted to review plans and estimates. Funds

had been transferred but not yet credited on the records. The OICC in Fairbanks would not sign a work order without specific authorization from BUDOCKS. So it went, and the SDARL became more exasperated and more frustrated daily. On April 29 the SDARL wrote ONR urging that BUDOCKS again be "needled" — "Though, instead of a needle, I would suggest a hat-pin."

Finally the log jam broke — on June 7 BUDOCKS wired the OICC to authorize the work. On June 26 the SDARL exulted ". . . you will be surprised at the difference that 251 is going to make in the laboratory.

"251 is going right along and if necessary we can use parts of it this summer for research and the sleeping quarters will be ready for the men to move into by, I think, two weeks."

As possibly might have been anticipated, The Johns Hopkins University very soon after it had accepted the contract to operate the ARL began to chafe at its largely operational role and the small responsibility it had in regard to the research work to be carried out by the ARL. Early in December 1949 Professor George Carter, the Chairman of the University's Isaiah Bowman School of Geography, wrote Dr. Field to suggest that the University designate a small committee as a means for "the University group assuming some intellectual role in the Arctic Research Laboratory program." He suggested that the proposed Committee —

1. Develop to the extent possible a coordinated program for the ARL.

2. Seek first quality men to undertake projects suited to the overall program.
3. Examine all projects submitted and present to the ARLAB their analyses and recommendations.

After obtaining the concurrence of the Chairman of the ARLAB, Dr. Field, by direction of the ONR, on December 13, 1949 authorized the University to proceed with the formation of the proposed committee and offered full cooperation in the development of programs for the ARL. Nothing much seems to have happened afterwards in regard to the proposed committee. In a note dated May 27, 1950, the SDARL commented that Dr. Carter was reported to have "dropped out of his committee he was so anxious to organize." Dr. Shelesnyak, as head of the Baltimore-Washington Office of the Arctic Institute of North America, in commenting on points to be reviewed by the ARLAB wrote in May 1950 to the Administrative Assistant of the ARLAB — "First, I think it would be nice to have the Board discuss the nature and extent of its activities toward stimulating research at the Laboratory. Second, I think there ought to be some report from Hopkins on its activities. I say this for although it was my impression that a group was supposed to be formed, and may have been formed on the campus in order to stimulate and excite and point out opportunities for arctic research at the Laboratory, I have seen no trace of such activity."

The oceanography program continued to be a problem to the SDARL through late 1949 and into 1950. On February 1, 1950 he set forth some of

his problems in an informal memorandum to the Administrative Assistant to the ARLAB. He pointed out that Colonel Balchen, USAF, was supposed to start flights out onto the Arctic Ocean for the oceanography program from Barter Island on February 1 but that he did not have any details. He apparently was seldom informed what oceanographers were coming to ARL, when, and to do what. He noted that the oceanography program was supposed to be an ARL activity and that it was inexcusable for him not to be informed — it reflects he said on the discipline and on the ARL.

On February 8 Mrs. Reamy replied that Mr. Knauss of the Geophysics Branch of ONR and Mr. Allen of the Hydrographic Office were coordinating the program and that the SDARL would be sent all details. She also reported that John F. Holmes was participating in the program and would get to northern Alaska about mid-March but did not expect to be at Barrow very much.

On February 27, the SDARL wrote again to say that Captain Diffley, USN, of Colonel Balchen's office was in to say that Balchen had been ready to begin operations on February 1. MacGinitie's note said, "If the oceanographers don't get on the ball and work energetically with Balchen I feel they will be missing their greatest opportunity in the Arctic . . .

"I received Mr. Knauss' letter and it's up to him and Hydro now. I have made arrangements with the local OICC to furnish transportation between here and Barter and the Commodore has written OICC Aubey to lend all aid possible so we have done all we can."

Again on March 10, MacGinitie wrote Mrs. Reamy that -- "It looks from here now as though Balchen will either use the Barrow strip or that he will not do the work this spring. Barter Island has closed down. As I said in my letter to Mr. Knauss, my complaint is that I have been here for nigh onto two years, yet nobody has actually tested out gear and gotten it together for a plane conveyance though they have known all along that this is in the offing."

Apparently it had long been the intention to invite Dr. O. M. Solandt, Chairman of the Defence Research Board of Canada to visit the ARL. On January 16, 1950 the SDARL reported that he had invited him. This visit was strongly endorsed by Commodore W. G. Greenman, Director of Naval Petroleum Reserves, and he urged the OICC for Pet 4 to offer all courtesies and assistance. Dr. Solandt, General Rodger of the Canadian Army, and Sir Hubert Wilkins arrived late in February and spent the better part of two days at the ARL. Later Dr. Solandt wrote the SDARL a fine letter of appreciation.

Solandt's visit may well have been influential in the later visit of the ARLAB to Fort Churchill, Manitoba but that later visit already had been discussed. In fact about the end of January, the Administrative Assistant of the ARLAB had informed the SDARL that Mr. Graham Rowley of the Defence Research Board had discussed with Dr. John Field a meeting of the ARLAB at Churchill in 1951. Dr. Solandt endorsed that tentative invitation while he was at Barrow.

VIP visitors to the ARL were not unusual and they came for many reasons — some just to see the North, others because of interest in some phase of exploration or research, and some because of interest in the oil exploration underway. Handling them took a lot of time and effort and of course cost money. The public-relations value of such visits was large, the visitors generally left full of enthusiasm, and the visits were probably worth the cost in time, trouble, and money. The brief recounting of just one such visit will illustrate the point.

On April 17 Dr. Field informed the SDARL that a Colonel T. Niell Rankin, Scottish ornithologist, and his son were planning to arrive in Fairbanks on May 6. The letter went on to point out that Colonel Rankin was the guest of the British Ambassador, that he wanted to stay in Barrow about a week, and that he should be extended all courtesies. It also stated that he wanted to collect some fertilized eggs of arctic birds for shipment to Scotland. The SDARL was perfectly willing to cooperate but he was doubtful of the practicability of getting the eggs. On May 18 he wrote to Dr. Field and said "I have checked with Tom Brower on the egg situation and he says that nobody knows where the blue goose nests. I am inclined to think he is mistaken in this but he is the only bird man in the country now. I also have been inquiring about king eider nests and all of the Eskimos say they nest more to the east of here — mainly over around Teshekpuk Lake. The SDARL later wrote similarly to Colonel Rankin.

Something apparently happened that headed the Colonel off for

an informal memorandum from someone in ONR informed the SDARL that "Whatever you decide to do about Colonel Rankin is all right with us. It is a shame he could not be cleared in time to go up but in the first place, the British Embassy decided to use a short cut to get entrance and came directly to us instead of to the Chief of Naval Operations. The CNO was wounded to the quick, evidently, and decided that either entrance be gained the correct way or not at all."

During Dr. MacGinitie's directorship occurred the tragic loss of one of the scientists of the ARL and of the pilot of the aircraft in which they were returning to Barrow from a long distance to the east along the north coast. The returning aircraft did not show up on May 9. A search was instituted but no trace ever was found. On May 16 Dr. MacGinitie wrote Dr. Field that "There is no sign of the plane that was bringing Hamilton back. The Air Force is still searching. It is altogether possible that they may show up yet. Hamilton is well able to take care of himself. They have a gun, ammunition and sleeping bags and, from what I hear, the pilot is a very capable person in this respect also." The search was still continuing on May 24 but by May 27 the SDARL reported "Most everyone seems to have lost hope in their having made a safe landing anywhere."

On February 24, 1950 the CNO directed RADM H. S. Kendall to make a survey of research and development facilities of the Bureaus and Offices of the Naval Establishment. "The objective of the survey is to determine the minimum essential organization, facilities and services

required to carry out naval research and development activities in peacetime . . ." The orders said the "survey will be conducted with a view to recommending all possible consolidations, reductions in individual facilities, and elimination of all facilities not essential for the performance of approved missions and tasks." Full cooperation of the ARL and of its responsible reporting point in ONR was given to Admiral Kendall and this resulted in a searching analysis of the ARL, its programs, plans, and accomplishments.

Largely through the initiative of Mrs. Yvonne Reamy, close working arrangements were established between Dr. Field's office in ONR and the Institute for Cooperative Research at The Johns Hopkins University that was managing the ARL contract for the University. The principal contact point at the ICR was Mrs. Jay W. McKee. It was suggested that much benefit might attain if Mrs. McKee could be sent to the ARL to see the Laboratory and the work going on there. Her visit however was not approved because of the difficulty of sending unattached women to the ARL.

Early in 1950 the long-awaited "Information Handbook for Contractors and Prospective Contractors for Research Projects at the Arctic Research Laboratory" was approved and became available. It was put to use immediately and became a most useful item in explaining to researchers contemplating going to the ARL the administrative, management, and financial matters that they should know about, as well as the

local conditions at Barrow and the things the ARL could and could not do for its project people.

After the termination of the contract with Swarthmore College, the former SDARL, Dr. Irving returned to Alaska. As he wrote to a friend on January 16, 1950, "Unfinished interests in northern Alaska were too strong to permit me to settle in other routines and I took the opportunity of joining the research program of the Alaska Health and Sanitation activities of the U.S. Public Health Service, now located at Anchorage. I will be concerned with working along two lines, (1) the adjustments of metabolism to arctic temperatures and (2) the distribution of animals over the Arctic slope."

On the same date he wrote the Chairman of the ARLAB of his plans to study bird migrations in the Brooks Range and adjacent areas both in and outside Naval Petroleum Reserve No. 4. He also requested information on Geological Survey plans in order to appraise the possibility of joining any Survey parties.

On January 24 the officer acting in charge of the Public Health Service in Anchorage wired Dr. Field in ONR for permission for Irving to visit the ARL about January 30. ONR replied that approval would first be required from the SDARL and the OICC of the oil exploration program and then only on assurance that the cost would be borne by the Public Health Service. On January 28 the SDARL approved the visit

and so informed the Public Health Service, Anchorage. There seems to be no record of whether or not the OICC granted permission but on March 1 the SDARL in an informal note to ONR said "Larry Irving arrived without clearance. The Commander allowed him to visit 1 hour here and then we shipped him to the village."

The next incident in the jockeying match came on March 30 when Irving wrote to Commodore Greenman, DNPR, of his plans for bird surveys, to be carried out with Thomas P. Brower of Barrow, and stating that he did not know if they would need to work in NPR 4 or not, but, if so, the letter constituted a request for permission to enter. The next day he wrote also to the SDARL apparently because "I have heard that you asked questions about my winter visit to Barrow and perhaps I should clarify the matter." He also offered full cooperation with the SDARL and the ARL.

In mid-April he wrote Dr. Field, Head of the Ecology Branch, ONR, and said "We are naturally embarrassed by the lack of observation of due courtesy and wish to present clearly our concern for the maintenance of cordial working relations." The matter appears to have ended with Dr. Field's letter of April 26 to Dr. Irving that contained assurances of the intent to maintain good working relationships.

On June 20 Mrs. Reamy reported to the SDARL that the Air Force was considering the establishment of a small geophysical laboratory at Barter Island, far east of Barrow on the arctic coast. This was under discussion in the Research and Development Board and had been mentioned

to the DNPR who thought it ridiculous not to use the ARL for the purpose. Doctor Field also felt that space could be made available at ARL. The RDB officially asked about space at ARL about the same date and on June 23 was informed that the 400 square feet needed could indeed be furnished on a continuing basis for a terrestrial sciences field laboratory. The SDARL was all for giving the space to the Air Force both because he was naturally cooperative and also because it would "insure the continuance of the laboratory if Pet-4 folds up." The arrangements were completed satisfactorily.

In a letter dated May 31, 1950 from the SDARL to Dr. Field came the first small hint that Dr. MacGinitie might be thinking about leaving for he mentioned "the incoming Director a year or so hence." He had been completely quiet about a health problem that must have been of great concern both to him and to Mrs. MacGinitie. Then on June 23 he wrote Dr. Detlev W. Bronk, President of The Johns Hopkins University, saying in part -- "I wish to submit my resignation as Scientific Director . . . and request that it take effect about September first . . .

"About a month ago I had a heart attack that the doctor says can be straightened out only by rest . . .

"I am very sorry that I cannot continue here, for I have a great interest in the Arctic Research Laboratory and I think its future is very bright. I have things in such shape here that I shall be proud to turn

them over to my relief." Then he wrote a moving personal letter to Dr. Field along the same line but in more detail.

The fact that the SDARL had a serious health problem that would necessitate his leaving as soon as a replacement could be found in no way changed the fact that the ARL had to go on with a well balanced research program during the summer of 1950 and that administrative matters perforce had to be handled by the SDARL at the ARL and by the ONR in Washington.

Some of these matters were insignificant relatively but still consumed a good deal of time and energy. Others were of greater and longer-range importance and affected the ARL for a long time into the future.

One of the researchers managed to perform a miracle of administrative confusion that was both frustrating and unnecessary. Apparently he arrived at Barrow early in July and proceeded the next day to Umiat. He was to be there a week and then spend several weeks at one of the Geological Survey camps deep in NPR4. He had hired an assistant in Fairbanks and had told the SDARL that he had arranged for the assistant to be paid by ARCON, which in turn would be reimbursed from the researcher's contract funds. Much to the surprise of the SDARL at Barrow the researcher, after less than a week at Umiat, was reported at Fairbanks and on his way south. The assistant appeared at Barrow and said the researcher had told him to go to work there but had not told him what to do. The SDARL was equal to the occasion and managed to straighten

out the matter but not before he had commented that he felt the researcher "must be off his nut".

The contract between ONR and the Smithsonian Institution for the operation of the ARLAB came up for renewal and required some discussion of various points. Sometime around mid-July that contract was renewed as of July 1.

Finances as always were a continuing problem but the problem was not as painful, as long drawn out, or as difficult as had been the case frequently in the past. The situation was reasonably well summarized in a memorandum dated July 19 from the ARLAB Administrative Assistant to the SDARL. Mrs. Reamy said -- "Sometime this month we are putting the sum of \$60,000 into Contract NOy-13360, Project 18. This amount covers the estimates forwarded to this branch by you, on April 22, 1950. In view of the rather fluid situation it was felt that a 20% contingency fund would be safer than 15%, even though costs of #251 would not come from this amount. This \$60,000, plus any present balance will run until 30 June 1951. Any unexpended balance will, of course, still be usable after that date.

"Inasmuch as the balance on the air support contract is, as of 18 June, \$6,507, we will let that ride for the present. Your estimate of \$16,540 was noted and will be kept on file . . ."

With the knowledge in the spring of 1950 that Dr. MacGinitie would be leaving the ARL, the matter of a replacement became urgent. The

first official move was to be consideration by the ARLAB of possible candidates for recommendation to the CNR. The Johns Hopkins University suggested that the Board remember that the first two directors were biologists and that special consideration might be given to candidates from geophysics, geology, oceanography, or other earth scientists.

A good many names were suggested but most of those proposed either did not seem to be suitable or apparently would be unable to accept. Two or three of the scientists engaged in the program at the ARL were carefully considered. From a number of sources came the suggestion that Dr. Ira L. Wiggins, already an old hand at the ARL, would be an ideal person for the position. It was generally felt though that he would not be likely to accept. To everyone's surprise, Dr. MacGinitie was able to wire to Dr. Field on July 29 — "Wiggins willing to have his name placed for nomination." On August 3 Wiggins himself wired ONR "Will accept directorship of ARL if nomination confirmed by Advisory Board." It was indeed confirmed by the ARLAB on August 7 and gratefully. By August 11 Wiggins had been approved by RADM Solberg, CNR, and a wire offer had been made to Wiggins in the name of the President of the University. Thus this most important matter was solved.

Another item was urgent and was discussed at the special meeting of ARLAB on August 7 — the future of the ARL. Two principal items were implicit in the thinking about the future. The first was the apparently increasing possibility that Pet 4 probably would not continue much longer.

The second was the tightening situation in regard to ARL support because of the developing Korean war.

In regard to the first point data were accumulated on the cost and operational problems involved if the ARL were to try to continue under its own steam if Pet 4 terminated. Points that were considered included, but were by no means confined to, availability of surplus facilities and materials from the Pet 4 operation, cost of operation of mess hall, shops, air strip, radio communications, power plant, and natural gas system. It was concluded that it could be done, but not easily.

The developing Korean war situation was requiring a careful scrutiny of all research activities and in general involved an attempt at consolidation of research activities of all three military services.

Both of the points mentioned above indicated the desirability, if the continuation of the ARL was deemed in the national interest, of encouraging the Army and the Air Force to initiate as many as possible additional projects at the ARL. The SDARL as of July 3 felt that ". . . now that we have the U.S. Army Engineers, U.S. Army Air Force, and the Navy interested in the laboratory, there is no reason why it shouldn't continue indefinitely." The Executive Secretary of the ARLAB, Dr. Field, felt that there would be an increasing amount of research and development at Point Barrow by all three Armed Services.

These trends, of course, while desirable from the standpoint of the most effective use of the facilities and as justification for continuation of the ARL were of some concern to the operating contractor, The Johns

Hopkins University, because there were likely to be more and more projects over which the SDARL would have little if any real cognizance.

A week or so after the special meeting of the ARLAB on August 7 Dr. J. E. Graf, Assistant Secretary of the Smithsonian Institution and alternate on the ARLAB to Dr. Wetmore, wrote a most thoughtful letter commenting on the above and other problems. His thoughts were very useful in later discussions. Among other things he said — "It is realized that funds for the laboratory are limited and that plans cannot be made for too heavy top administrative expenses; but in spite of this, it seems clear that top administrative layer must be strengthened in the interest of continuity in smooth operation. It seems clear that the scientific director will serve only for short periods, often for only one year, probably seldom over two. In this contingency it is going to be rather difficult to have smooth administration, at least as far as personal relations are concerned, and these are more important at Point Barrow than would be the case in an average laboratory. Why would it not be a good plan to have serving under the Director a general manager or assistant director who would be a man not necessarily possessing scientific attainments but one who appreciates scientific work and would have direct charge of maintenance of the buildings and equipment and the assignment of field equipment. Probably a man of this character would be willing to stay five or ten years, and he would greatly soften the shock of shifting from one scientific director to another.

"The Director's authority should be spelled out very carefully both as to supported and as to unsupported projects. It is obvious that some of these projects may be quite secret in nature and that he would have very little to do with them beyond the assignment of laboratory space and equipment, but he certainly should have powers as regards the enforcement of laboratory rules, because they affect every scientist at the laboratory. The duties of the Director are spelled out very well, but it seems obvious that ARLAB had its bleary eyes fastened on supported projects. The presence of unsupported projects of varying secrecy complicates the situation. Writing these into the Director's job description is not easy. Why couldn't the job be done by preparing basic Laboratory rules — not by the Director but some approved by ARLAB, ONR, and Hopkins. Such rules could not be brushed aside too easily."

The ARLAB at work

During the interval described earlier in this chapter, the ARLAB concerned itself as needed with the problems of the ARL and advised in regard to most of the problems and situations that arose. The first formal attention to business after Dr. MacGinitie took over was at a meeting of the Executive Committee of the ARLAB on August 23, 1949. Present were John C. Reed of the Geological Survey, Chairman; Dr. Shelesnyak, Executive Secretary; Dr. John Field, Head, Ecology Branch, ONR; and Mrs. Yvonne Reamy, Administrative Assistant to the Executive Secretary.

Among the items discussed were the advisability of appointing alternates for the Board members; progress at the ARL under the new Scientific Director; the inauguration of systematic newsletters (monthly) and scientific progress reports (also monthly); the possibility of an ARLAB meeting at Ft. Churchill; and the compilation and publication of the results of the Swarthmore contract under a proposed extension of that contract. The Executive Committee recommended against the last-mentioned item because it felt that publication should be accomplished through appropriate scientific journals.

The Executive Committee again met on October 5. By that time Dr. Field had replaced Dr. Shelesnyak as Executive Secretary. Dr. Shelesnyak had taken over the directorship of the Baltimore-Washington Office of the Arctic Institute. He was invited to become a regular member of the ARLAB and accepted.

The first full meeting of the ARLAB after the taking over of the operation contract by The Johns Hopkins University was held in Rogers House at the University on November 29. The following members were in attendance →

Dr. Detlev W. Bronk, President, The Johns Hopkins University

Dr. John Field, Head, Ecology Branch, Office of Naval Research

Commodore W. G. Greenman, Director, Naval Petroleum and Oil

Shale Reserves

Dr. Ellis A. Johnson, Director, Operations Research Office, The

Johns Hopkins University

Dr. Remington Kellogg, Director, U.S. National Museum

Professor G. E. MacGinitie, SDARL

Dr. John C. Reed, Staff Geologist, U.S. Geological Survey, Chairman

Dr. Roger Revelle, Director, Scripps Institution of Oceanography

Dr. J. Frank Schairer, Geophysical Laboratory, Carnegie Institution of Washington

Dr. M. C. Shelesnyak, Director, Baltimore-Washington Office, Arctic Institute of North America

Dr. Alexander Wetmore, Secretary, The Smithsonian Institution

In addition a number of guests, mostly from ONR and from the University were present by invitation. A good deal of business was done that day and only a few selected salient items are reported here. These have been chosen because of their intrinsic importance to the ARL or because they significantly affected ARL operations later.

The SDARL reported on the building situation at the ARL. He also mentioned some settling of the main building because of the melting of permafrost under it. Dr. MacGinitie was concerned about the morale of the investigators and was constantly seeking ways to make their tours more pleasant and profitable. In this connection he reported a prospectus for investigators that contained the regulations pertaining to NPR 4 as well

as to the ARL alone. The prospectus called attention to certain applicable parts of the game laws and regulations as well as regulations covering relations with the Eskimos.

The Board was pleased with the Newsletters and Progress Reports and also with adult education classes that were being given on a voluntary basis by Dr. MacCarthy in general geology and by Dr. Wennesland in human biology. Also the Board seemed to feel strongly that occasional meetings of the ARLAB in the Arctic would be desirable. A long discussion explored the types of projects that can be carried out at the ARL and the place of the Board in regard to their review and approval. Even to men as experienced as most of the Board members the complexities of relationships were not entirely clear. They were uneasy in regard to their own responsibilities when they contemplated ONR as the source of funds and administrative responsibility; an operational contract under The Johns Hopkins University that included provision for the SDARL; the place of the Arctic Institute of North America that had a share of the responsibility in regard to projects; the fact that military projects were included with which the ARLAB had nothing to do; the fact that the DNPR had a large part in the control of NPR 4 but that the OICC at Fairbanks and the ROICC at Barrow reported to BU-DOCKS; that military control was exercised by the Commandant 17th Naval District in Kodiak; and the place, authority, and responsibility of ARCON. It was confusing, but it was logical in a way too, and it did work surprisingly well.

The Board considered and rated about 10 proposals for research at the ARL. Five of these were placed in the highest category and were then arranged in a recommended order of priority for support as follows:

1. The continuation of the oceanography program for the coming year. The program would include development of ice-landing techniques, observations at Point Barrow, and oceanographic techniques and studies of gases.
2. A proposal of A. R. Loeblich, Jr., of the Smithsonian Institution to study arctic foraminifera and compare them with Pleistocene faunas.
3. A survey of the insect and related arthropod life of the Arctic (a continuation) by Neal Weber of Swarthmore College.
4. A proposal by Ira L. Wiggins of Stanford University to make ecological and taxonomic investigations of vascular plants.
5. A study of the significance of lower freshwater invertebrates by Roman Kenk, AINA.

A few other items of significance were discussed. The closest possible cooperation with the University of Alaska was urged. The possibility of the ending of the oil exploration in and near NPR 4 was raised and its possible effect on the ARL was reviewed.

The Executive Committee of the Board again met on January 6, 1950 and conducted a few items of routine business. It was reported that four of the five project proposals that had been rated highly by the ARLAB on

November 29 were moving toward ONR support. In addition it appeared that ONR might be able to support a project on the adaptation to climate of arctic animals that had been proposed by Dr. Charles G. Wilber of St. Louis University and that had received a Board rating in the next to the highest category.

The ARLAB assembled in Washington for its sixth meeting on May 31, 1950. Attendance was poor and five members were absent. Two new members had been appointed since the meeting in the previous November — Dr. George Carter, Chairman of Isaiah Bowman School of Geography, The Johns Hopkins University, and Dr. T. J. Killian, Science Director, ONR.

Dr. Carter announced to the ARLAB the appointment of a Johns Hopkins Advisory Committee that previously has been mentioned. That committee seems never to have been active. The SDARL could not be present at the meeting because the date was at the start of the summer season at the ARL and because a building program was just about to get underway. He sent a complete report, mostly on items that are covered elsewhere in this chapter. These included building plans and progress, the problems of vehicles at the ARL, the satisfactory quality of the ARL administrative staff, and the continuing limitations of the oceanography program.

The long-standing concern of the Board with its place in the scene

again came up for discussion. The Board requested a report at its next meeting on all investigations undertaken at the ARL since its inception. It was agreed that in the future all projects at the ARL not under the scientific cognizance of the ONR be listed separately and identified as to support source. The place of the AINA in regard to some projects was again aired. Finally the authority of the SDARL in regard to programs not under ONR cognizance was explored. It was pointed out that the SDARL controlled the facilities and hence could deny them to groups not willing to abide by the rules and regulations. Dr. Field stressed that the ARLAB was a policy group and not an operational group.

At the May 1950 meeting plans were announced for the operation of the ARLAB by the Smithsonian Institution through a small contract with ONR. The limitations of the oceanography program were reviewed on the basis of the SDARL's report. A good deal of improvement in the program was evident, but Dr. R. H. Fleming of ONR, a guest at the meeting, was asked to prepare a review for the next meeting.

Then the Board got down to cases on the future of the ARL when and if the oil exploration terminated. The DNPR pointed out that Pet 4 was to be halted if an oil discovery was not made before December 1952. The Board recommended by formal motion that ONR, with the SDARL and the OICC "investigate what material, equipment, costs, personnel, etc. will be required to maintain the ARL if and when the oil exploration

program is discontinued" The Board also recommended the continuation of the research project of Dr. MacGinitie and the renewal of the contract with The Johns Hopkins University for the operation and administration of the ARL.

By the summer of 1950 it was generally known that Dr. MacGinitie would be unable to continue long as SDARL because of ill health. With regret a special meeting of the ARLAB was called on August 7 to consider candidates for his replacement in order to make a recommendation to the ONR. The Chairman presented a letter from Dr. MacGinitie that expressed his satisfaction in having had an opportunity to serve and his regret at leaving. Typically the bulk of his letter was used to commend his staff including four permanent Eskimo help — Chester Lampe, Jake Stalker, Pete Sovalik, and Charlie Tuckfield. He especially commended Mrs. Yvonne Reamy and took pains to specify the many aspects of her assistance.

After full discussion the ARLAB unanimously recommended that Dr. Ira L. Wiggins, Director of the Natural History Museum, Stanford University, be named as the next SDARL. That Dr. Wiggins was not planning to remain long was implicit in a request to the Chairman to appoint "a committee composed of the Chairman and two or three members who will engage actively in the next several months in looking for a Scientific Director to replace Dr. Wiggins at the expiration of his one year term."

Other changes were brewing also: The special meeting was attended by CAPT Robert H. Meade and Vice Commodore Greenman, and it was known that CAPT Meade would soon relieve the Commodore as DNPR. Later CAPT Meade completed a distinguished naval career as RADM Meade, Chief of BUDOCKS. At the meeting Dr. Shelesnyak, who had had so much to do with the founding of the ARL and who currently was the head of the Baltimore-Washington Office of the AINA, announced that he would be leaving the AINA shortly to accept a post with the Weismann Institute in Israel.

Captain Meade expressed some concern over the future of the ARL at the anticipated closing of Pet 4. He urged that some applied research be undertaken as an additional justification for the laboratory. Capt. W. H. Leahy, Assistant Chief for Research, ONR, who was in attendance recognized some shift of emphasis from basic to applied research but said that it was intended to keep a fundamental research program going and that there always will be a need for basic research in the Arctic.

Local administration

The real firing line of administration of the ARL, of course, was at the Laboratory at Point Barrow. There each SDARL was tested again and again and George MacGinitie was no exception. Although he knew the ARL well, having been there before as a researcher, on his arrival as SDARL on June 30, 1949 he suddenly faced a host of baffling, complex problems that had to be handled somehow. Furthermore, the previous SDARL had

already left at the time of MacGinitie's arrival and various factions, groups, and individuals were eager to apply their various pressures toward their own ends. It was MacGinitie's lot to try to sort out the pressures that were selflessly designed to help the ARL toward a more rewarding program, and there were a lot of that type, from the moves that would advance only the special, often unjustified, causes of self-centered individuals or groups. Many of the problems, most of them in fact, were insignificant judged by normal standards, but remember that the ARL was a tenant facility deep in the Arctic. People lived too close together twenty-four hours a day, every day. The bulk of the camp was concerned with an oil-exploration program and had little time for concern for the problems of a group of researchers. Dr. MacGinitie moved in swiftly with characteristic tact, humor, good judgment, a fair mixture of determination, and the patience of Job.

Even reaching Point Barrow had been something of a trial and he and Mrs. MacGinitie must have been bone tired on arrival. Here, as a sample, is just a part of their trip from Corona Del Mar, California, which they left on June 20, to Point Barrow. "Nettie's room at the Dependents Guest House in Anchorage was clean, but the room that Feder and I were in at the BOQ was just plain dirty . . .

"There was no transportation out of Anchorage the next day, Sunday, and since no plane transportation could be promised before Wednesday,

we took the train from Anchorage to Fairbanks, each paying his own fare. We left at 8:30 Monday morning and were scheduled to arrive in Fairbanks at 10:00 that night, but it was about 2:30 the next morning before we actually reached there . . . we had to wait nearly three hours for a slide to be cleared away and a bridge repaired . . .

"There was no plane out of Fairbanks until Thursday, in fact, there had been no Barrow planes since the preceding Saturday . . .

"There were 24 passengers for Barrow on Thursday and the flight was delayed 1.5 hours while more seats were added to the plane . . ."

Within a week a group of problems and minor crises landed in his lap. Here are a few selected from MacGinitie's first Newsletter. On the day he arrived he had a conference with a representative of the Hydrographic Office about the oceanographic program; and another with Mr. R. Nelson of the Fish and Wildlife Service about his work. Neither of the projects was really a part of the ARL program but they were "under the wing" of the SDARL.

His first attempts at developing good relations with ARCON were complicated by ARCON's exasperation over an ARL researcher who had left a day or two before MacGinitie's arrival and who had left scattered equipment and personal belongings behind for someone else to pack up and ship to him.

Even the MacGinitie's quarters presented a problem or two. "Mrs. Cunningham, wife of the Navy auditor, had mopped and dusted our hut and furniture after Clason and one of the Eskimos had swept it, so we were able

to move in without a cleaning session. We were indeed grateful, for seven subsequent sweepings and moppings have failed to remove all the hairs contributed by three dogs. The mystery of bleached spots on the floor was finally cleared up when we learned that three days before their departure the previous occupants had bathed their three dogs and did not once allow them to go outside, saying they preferred to clean up after them rather than let them outside to get dirty before they left."

The visitors arrived, as they did frequently, this time RADM F. D. Wagner, Commandant 17th Naval District, and the OICC from Fairbanks. Protocol demanded the participation of the SDARL in welcoming such personages.

And on July 2 came a letter from the head man of the Eskimos at Anaktuvuk Pass, Simon Paneak, asking for more supplies "and mentioning the \$10 per day that he has been paid for some time. I sent back word that there would be no more work and supplies until further notice, for I wanted a little time to investigate this Anaktuvuk affair. . . ." And so it went.

There is a temptation to include much more from MacGinitie's records than any reasonable budget of space will allow for his reports are interesting and the enjoyment he felt comes through clearly. For example, in regard to handling Eskimo help, "One of the main faults of the Eskimo workmen is absenteeism. The Contractors fight it all the time, and although they do not pay them when they do not come to work, it is of small import to

the Eskimos, who are already getting more money than they know what to do with. Hoover and Carl (ARL Eskimo workmen) did not report here for work on Saturday. I tried to impress on them that only dependable men are wanted at the laboratory and if they did not come to work regularly they can stay home — permanently. The Judge (U.S. Commissioner Hugh Saltzman) tells of an Eskimo who was being questioned concerning his absence from work. The Eskimo explained his absence of several days by saying that he wanted to catch up on his sleep. He was told that they would not tolerate any more absences and that he would either come to work or they would let him go. He agreed to come to work, but asked if he could have two weeks first. When he was asked why he wanted two weeks off he said that he wanted to catch up on his sleep."

On August 2 the first of the ships that made up Barex 1949 (Barrow Expedition) arrived with the materials for the next year. "As soon as the ships came in, Arctic Contractors workmen stopped work on anything that could be postponed and helped with the unloading and storing of cargo. The connection between Building #250 and #251 was nearly finished, but its completion is dependent upon some lumber, principally flooring, that is on the ships. Likewise, work on the office, which is being divided into an office for the director, one for the plant manager and the clerk-librarian, and three stalls for scientists who merely wish to write or work on their data, was stopped until the cargo rush is over. The same applies to the third ONR quonset hut for married couples. It is now enclosed, but no further work is being done."

And so the fall wore on and early winter arrived. The days became shorter and colder rapidly and many of the summer workers departed. Weekly seminars by ARL personnel were instituted and rapidly became an attraction to other laboratory personnel but mostly to ARCON and Navy people at the camp. The average attendance ran about forty and considerable interest was shown in the possibility of holding adult education classes.

Plans were made to hire an Eskimo as an animal man for the laboratory. Curiously little seemed to be known about caring for and rearing such common local animals as the ground squirrel (sic sic) and the lemming. It was noted that the acquisition of sic sics alone had cost the ARL several thousands of dollars and still they were not always available when needed.

Dr. John R. Paul of the Armed Forces Epidemiological Board had been collecting blood samples from the Eskimos at Barrow for study. The SDARL reported with amusement "Toward the end of his work . . . Dr. Paul said the number of volunteer blood donors began to dwindle and in order to encourage more people to come he offered free medical advice. Not only did he get new donors but all the former donors came back for their just rewards."

In September the SDARL reported that his campaign against absenteeism among the Eskimos apparently was working. He commented too soon for the following month he had to say. "Ray (Ahnupkana) did not report for work today. His brother says he has gone caribou hunting. We are sorry to lose Ray; he was a good worker while he lasted."

Also in September the connection between Buildings 250 and 251 was nearly completed and the moving of the shop into that area awaited only the electrical installations. Detailed plans also were underway for the equipping of Building 251. In general the planning, negotiating for, and completion of 251 was one of the real accomplishments of the MacGinitie administration. By the end of the year the general condition of the ARL was reported to be good. Painting and upkeep had been done. The shop was completed and occupied and other improvements had been made.

Something of the atmosphere of the area in the winter comes through in the reporting of a concert given by a visiting Fairbanks musician in the Barrow Presbyterian Church attended by both Eskimos and visitors to the total number of 400 people. Highlights were reported as "Dr. Reidar Wennesland amusing a restive Eskimo baby during Mrs. Montgomery's rendition of Kreisler's 'Leibesleid' . . . two smacking reports from a cap pistol fired by a fun-loving young chap in the back row . . . the large baby chorus which picked up each refrain . . . the crowd carefully stepping over sleeping children as the church was cleared after the concert."

In mid-November the SDARL left for the States but the program went on as usual in his absence. The report of a Christmas party is typical — "The fact that a tree once grew in Brooklyn pales into insignificance beside the fact that a real, honest-to-goodness Christmas tree suddenly sprouted in one corner of the library.

"An hour-long Christmas program was presented by the Point Barrow

Glee Club in the Lab library this evening. Some 70 or 80 members of the camp complement gathered to listen to the old-familiar carols. The entire camp is indebted to the Glee Club for lifting this Christmas above the level of just another Christmas in Barrow."

At Barrow the weather is always a subject of interest and concern because most of man's activity is immediately and directly influenced by it. The SDARL reported in his news letter that the thermometer reached -34°F . on January 21 and that the stove in the married couples dining room ran out of oil. "Hot food was nearly cold by the time it reached our mouths and the table ware was so cold that one lady put a glove on her right hand and another wrapped a napkin around her fork handle." On the very next day the thermometer stood at $+22^{\circ}\text{F}$.

On March 20 it was -20°F . and the data revealed that February had been the coldest month recorded since the weather station was established. The average daily temperature was -23.8°F .

At the end of January a doctor, employed by ARCON, reached the Barrow camp. The facility had been without a doctor for many months. Also late in January an unfortunate polar bear wandered into the camp and was shot by one of the Eskimos. The carcass was soon on its way to the village by dog team but some of the liver, muscle, and intestine were sent to Dr. Rausch of the Public Health Service who had been studying the prevalence of Trichinella in arctic carnivores.

During the early part of 1950, the ARL mechanic devised an ingenious ice-cutter. He also developed a unique method of building snow houses. These were used for covering holes through the sea ice through which plankton hauls were made or fish traps lowered. The houses prevented the holes from freezing in from the edge and, when heated by a lantern, provided shelter and some warmth for workers. The houses, which were of quonset-hut shape, were constructed with the use of a light, half-circular form that could be moved along after each course of snow blocks was laid over it. The houses were 8 feet wide, 6 feet high in the center, and could be made any desired length. In March one of these houses was split up the middle, fortunately while it was unoccupied, by a crack in the ice. By the next morning half of the house and some of the instruments were gone and the other half perched on the edge of an open-water lead at least 200 yards wide.

Illness was a real problem during the late winter of 1950 and is referred to again and again in the records. The disease was locally called "Eskimo flu" and it was especially virulent among the natives although the outsiders were by no means immune. For example, on March 23 the SDARL reported — "Pete and Hoover are ill, and Jake was taken home ill after he had come to work. So many people in the village are ill that the school has closed. Half of the natives working for ARCON are absent."

The next day, March 24 — "We have half an Eskimo crew today — Hoover reported back to work, but Pete and Jake are still out . . . Mrs.

Wickham is on the sick list again — this time with 'Eskimo flu.' Gene Austin has joined the sick list, too."

And so the ARL went through the long, cold winter. Little wonder that the rapidly lengthening days of spring were welcomed with continually rising spirits.

During all of his tenure as SDARL, Dr. MacGinitie was deeply involved in the acquisition and improvement of ARL buildings — in large part Building 251 and the connection between it and the main building, No. 250. Various aspects of the building program have been discussed elsewhere but the persistence and energy of the SDARL on the ground are what made the program successful. His deep concern with proper housing for the ARL crops up frequently through his reports. For example in the Progress Report for March 1950 — "Arrangements are being made to take over building 251 and equip it with laboratory rooms downstairs and with sleeping quarters upstairs. A small reading room will be provided upstairs. This room together with the facilities furnished by the Library in 250 will afford ample space and quiet for research or other reading.

"A garage will be made in the north end of 251 downstairs to accommodate two weasels and a jeep. The efficient use of these vehicles will be much enhanced thereby."

In early April the SDARL recorded a strenuous week. "Supervising four Eskimos downstairs while attending to office work upstairs keeps one person on the double. The Eskimos need someone with them practically

all the time for there are so many little things that they are unfamiliar with and do not know how to do — things that anyone who has been his own handy man around a home does without realizing that there is a wrong way to do them or that people have never seen done."

April 10 was the warmest day to that date, being 26° F. above. "The laboratory roof leaked buckets full of water. Buckets were stationed on the tables and all over the floor of the library and office . . . There is very little snow on the roof now but the four inches of insulation is apparently full of frozen condensed moisture and snow that drifted in during blizzards."

Much effort was extended in April in cutting ice holes for setting fish traps. One hole was through 7 feet of ice but mostly it was possible to find places where the ice was only 5 feet thick.

On April 27 appeared the first snow bunting — the Barrow equivalent of the first robin farther south as the harbinger of spring. The SDARL wondered what he could find to eat as the tundra was still covered with snow.

Only two days later the personnel of the ARL watched a whaling operation. The SDARL's description is vivid — "Routine work at the laboratory was interrupted in mid-afternoon when word was received that one of the whaling camps had a whale. A general exodus in the directions of the camps (located out on the sea ice) followed — and only Harry remained to hold down the fort. By six o'clock about 300 Eskimos were at the camp with approximately 50 dog teams. An acre of ice was occupied

by family groups around their sleds or around gasoline or oil stoves heating water in preparation for cooking muktuk (whale skin, an Eskimo delicacy).

"The whale, a young bowhead not much over 25 feet in length, was drawn out of the water onto the ice by means of a block and tackle attached to the tail and anchored to the ice. Two triangular holes were made in the ice about 18 inches apart and to a depth of 2 feet and then a hole was made under this 18-inch by 2-foot section so that a rope could be drawn under it. The pulling is then done by hand — many hands.

"Even before the whale was out of the water pieces of muktuk had been cut off. Some of it is eaten raw, but most of the Eskimos seem to prefer to cook it when it is fresh. Once out of the water the animal was soon flensed and strips of the muktuk were dragged out of the way with hooks and later hauled to the village on sleds."

In describing the taking of another whale, the SDARL commented on the eating of muktuk by ARL personnel. He said — "Several were daring enough to try eating raw muktuk; the chief requisite for which is a strong pair of jaws and a good set of teeth — coupled with an open mind, of course."

As mentioned earlier Dr. MacGinitie was unable to attend the ARLAB meeting at the end of May. His report dwelt at length on the building situation — not only the new building, No. 251, but also family quarters and the status of No. 250. Building 250 was continuing to sink into the

permafrost and the center of the library floor was 2 1/2 inches below the walls. A third family building (each of them housing 2 families) was newly finished. He reported four families in residence and room for two more because of the new building.

His concern over the new laboratory building and his satisfaction in seeing it near completion is shown by one small paragraph in his report — "It is only after one is here for a time and sizes up the situation that the importance of #251 as a part of the laboratory set-up is realized. The big advantage will be having everything under one roof, having a storage space for vehicles where they can be started at anytime on cold winter days, convenience especially during the cold months, for workers to get to their laboratories, and more pleasant living conditions."

The SDARL's report also summarized the planned program for the summer of 1950 as:

Dr. Neal Weber and one assistant	Insects
Dr. Ira Wiggins and two assistants	Botany
Dr. X. J. Musacchia and three assistants	Fats and Lipids
Dr. B. J. Sullivan and one assistant	Tissue Analysis
Drs. R. Rausch and E. W. Schiller	Parasitology
Dr. R. Wennesland and one assistant	Tissue Metabolism
Dr. Lloyd Spetzman	Botany
D. A. B. Loeblich	Forams
Dr. and Mrs. G. R. MacCarthy	Geology

Dr. and Mrs. R. F. Black	Geology
Mr. G. Scholl and Mr. W. E. Austin	Earth's Magnetic Field
Mr. and Mrs. J. B. Wickham	Oceanography
Mr. R. N. Rowray	Oceanography
Mr. and Mrs. G. E. MacGinitie & 2 asst's	Marine Organisms
Mr. R. D. Hamilton	Mammalogy

Apparently when the SDARL wrote the above part of his report, hope had not yet been given up for Mr. Hamilton. That tragic incident has been reported earlier. His loss and the long period of slowly waning hope that he might yet be found were severe blows to ARL morale. The whole incident is fully reported in the record but is not dwelt on unduly. Only a little reading between the lines indicates how much it was in each person's mind.

About the first of June the refrigerators at the ARL were connected to run on natural gas and the use of kerosene for fuel for them was discontinued. Performance with gas fuel was greatly improved. Using natural gas found in a moderate-size field only about 5 miles from the main camp was a real accomplishment of the Pet 4 program. It made a great difference in efficiency and obviated subsequently the need to ship large quantities of fuel to Barrow.

Dr. Rausch and Mr. Schiller early in June travelled to Wainwright, an Eskimo village down the coast southwest of Barrow, to pick up biological materials that they had arranged for the villagers to collect for them. They

returned with the intestines from 80 owls. The villagers had eaten the rest of the owls.

The MacCarthy's reported on June 15 the worst tundra driving that they had encountered in a weasel. They had driven to the gas field a few miles to the south of the ARL but the snow was partially melted and parts of the tundra soft and mushy. Apparently firm snow patches gave way and let the weasel into the mud or, worse, one side into the mud. They enjoyed the opportunity of seeing a variety of birds at close range — owls, geese, ducks, gulls, phalaropes, and jaegers.

And so the longest day approached — on June 19 the ARL boat was hauled to the beach and the mast hoisted in preparation for launching as soon as the ice of the ocean went out. On that day there was a shore lead of open water a mile wide but the pressure ridge a mile out still held fast.

On July 31 the advance contingent of the 1950 ship expedition (Barex 50) arrived off the Pet 4 camp. It consisted of an icebreaker and three LST's.

The ARL Newsletter for July 1950 was the last one prepared by Dr. MacGinitie. On August 11 the SDARL announced that he was being relieved by Dr. Ira L. Wiggins who would be Acting SDARL until September 1 and then would become SDARL. Everyone knew the move was in the wind but the reality of seeing MacGinitie prepare to leave saddened all who knew him at Barrow — the ARL people, employees of ARCON, the Navy, the villagers, everyone. There followed good-by parties, teas, best wishes, and gifts until the well-loved pair actually departed on August 15.

One of the most heartfelt tributes to the MacGinities appeared in the ARL Progress Report for August — "The departure from the Arctic Research Laboratory of Professor and Mrs. MacGinitie left a large gap in the lives of the rest of the laboratory family. His sterling services to the Laboratory during his term as Scientific Director had done much to place the Laboratory in a favorable light with prominent scientists. He had established very fine and cordial relations with the officers of the Arctic Contractors and with the Navy and other government agencies at the Barrow Base. Only the urgency involved in his need to return to his home at Corona del Mar to regain his health deterred all of the people with whom he had associated at Point Barrow from strongly requesting him to reconsider his decision to resign from the post he had filled so capably at the Arctic Research Laboratory. The sincere best wishes for speedy and full recovery were extended to him on his departure."

Thus ended the administration of the second SDARL. The change came well along in the field season of 1950. Just 11 days after he left, the bachelor members of the ARL team moved into the new quarters on the second floor of Building 251, the preparation for which had occupied so much of Dr. MacGinitie's time and effort.

IRA WIGGINS, BOTANIST, BECOMES SCIENTIFIC DIRECTOR

In August of 1950 Dr. Ira L. Wiggins, a botanist of wide and favorable reputation and Director of the Natural History Museum of Stanford University, quietly and without fanfare smoothly took over the reins of ARL direction from Professor MacGinitie. He was, of course, an experienced hand at the ARL, having carried on research there in the summer of 1950, and after having surveyed the opportunities on the ground at Dr. MacGinitie's request in September, 1949. He remained firmly in the saddle until the end of January, 1954—longer than either of his predecessors.

Problems there were in abundance when Dr. Wiggins became SDARL, but the problems were reasonably well identified, a good deal of thought had been given to them, and there was a growing body of experience on which to base decisions.

As Dr. Wiggins began to grapple with the problems of his new position, it soon was apparent that one of his primary concerns was going to be the broadening and strengthening of the research program. Especially he felt that more emphasis was needed in the physical sciences.

Thus started the incumbency of the third SDARL. The first was a physiologist; the second, a marine biologist; and the third, a botanist.

The Research Program Gains in Size, Strength, and Diversity

Planning the research program

The content and nature of the research program were questions constantly on the table from the outset. As the program expanded and became recognized by leaders in both basic and applied sciences, discussion and debate were provoked on the desired scope and range of arctic research to be promoted. The ONR approach was to support a broad scientific research program. This approach was supported strongly, for example, by Dr. Detlev Bronk of The Johns Hopkins University, who stated at the seventh meeting of the ARLAB on November 14, 1950 that "the National Academy of Sciences would be interested in seeing the continuance of the ARL from the standpoint of the foundations of civilian science."

At its ninth meeting on May 16, 1951 the ARLAB noted from the ONR report that approximately 60 percent of the man-years of research at the ARL had been in the biological sciences and 40 percent in the earth sciences, principally geophysical studies. The Advisory Board expressed its satisfaction with that ratio. At the same meeting the Board recommended that a competent group make an "analytical study of the strategic and tactical significance of the Arctic with a view to the formulation of an integrated research program for military purposes". The Board also

asked for an indication of the degree to which the ARL might be the place to carry out such a program. The ARLAB request ran into "procedural problems" and was not met, although the Board continued to indicate its interest in such a study.

At the ARLAB meeting in January 1952, which recommended approval of the 1952 research program, Dr. Quam, for the Office of Naval Research, said that the ONR was interested in a broad arctic program. The Navy interest, he said, was in the environment as related to naval operations, but the ARLAB "should feel free to recommend any program it desires."

Before the Advisory Board met again on November 24, 1952, an arrangement had been made between the ONR and the National Science Foundation. Under that arrangement, the NSF had indicated that because its interest in the broad field of biological science extended to the Arctic, it agreed to support the arctic programs in systematic biology, archaeology, and anthropology. ONR would continue to provide logistic support at the ARL or in the adjacent area. Dr. Frank Johnson, speaking for the NSF at the ARLAB meeting, admitted that despite NSF interest, its limited research funds would not permit it to furnish large scale support in any geographic area. The possibility of support for the arctic program by the Arctic Institute of North America was also raised by Dr. Quam at that meeting. In 1953 the AINA technically became the

supporter of most of the private institution projects, generally with funds supplied by government agencies. The NSF gave partial support to one project, ONR supported four projects and several others were supported by other sponsoring government agencies.

In its Progress Report at the end of 1953, the ONR outlined its future plans for the program and stated that—"Particular emphasis will be given studies for providing the Navy with basic and applied information which will improve and perfect its ability to operate successfully in arctic and cold-weather situations. In addition to research that will supply accurate knowledge of the characteristics and relationships of the environmental factors, detailed studies in such fields as permafrost, soils, microclimate, beach and near-shore forms and processes, radio propagation, magnetism, sea ice, acoustics, and oceanography will be carefully designed to provide a maximum of new information immediately applicable to naval problems of trafficability, construction, logistics, survival, rescue, and to amphibious, undersea, surface and air operations."

As Scientific Director of the Laboratory, Dr. Wiggins, on occasion, expressed his own views on the content as well as the size of the research program. For example, in a memorandum to Dr. Louis Quam, ONR, dated August 24, 1951, Dr. Wiggins gave his support to a still greater broadening of the program at the ARL. In doing so, however, he outlined his views on some limitations which he perceived. He wrote—"On the

other side of the ledger, may I point out that it might not be practicable nor desirable to completely fill some of the gaps which academically seem to occur in the program of ARL when this program is compared with the overall program of ONR. For example, I doubt very much that it would be good economy to assign a project dealing with human resources or most of the applied sciences or pure mathematics to ARL. Such work could probably in most cases be carried on much more effectively in the U. S., where the logistic problem is virtually non-existent, and it therefore would be unwise to expend funds to support such projects at Point Barrow to the extent that they would have to be expended to keep a staff of workers housed and fed at this outpost. The same impracticability would probably apply to several sub-branches in the physical sciences, such as nuclear physics, electronics, and other highly theoretical and technical projects. I will grant, of course, that certain phases of some of these various projects might be carried on with great profit at Point Barrow, and if such can be suggested and properly supported, I would heartily recommend the consideration of favorable action."

At the twelfth meeting of the Advisory Board on November 24, 1952, Dr. Wiggins pointed out that seventy-six stations for arctic research had been counted in Russian territory, whereas "There is one in American held territory." He concluded that most of the research that had been carried on at the ARL had "a very definite applicability". He also pointed out that

every time a team of scientists went to the Arctic "they are learning how to operate there".

At its last meeting, on April 13, 1953 the Advisory Board expressed itself as being strongly in favor of continued arctic research and resolved that, "an advisory mechanism be established to coordinate arctic research carried out under the cognizance of the ONR".

Evaluation of the program

At the meeting of the Arctic Research Laboratory Advisory Board in November, 1952 Dr. Wiggins had reported that he had found the research program successful beyond normal expectations. Even those projects, he said, about which he had at first been doubtful "were conducted in such a way as to remove the necessity for apologizing for recommending their approval".

In his monthly report for November, 1953 Dr. Wiggins reported with obvious gratification that, "During the month the Scientific Director received word from several investigators that the analysis of data and preparation of technical reports and papers were moving along satisfactorily."

In a letter to Commander M. V. Carson of the Office of Naval Petroleum Reserves dated November 10, 1953 Dr. Quam summarized briefly the accomplishments of ARL as he saw them. He wrote:

"The investigations carried on at ARL since its establishment in 1947 have varied in their emphasis in accordance with the interests of the

Scientific Director. During its early years, the laboratory was directed by Dr. Laurence Irving and the concentration of interest was in physiology. Work was done on epidemiology among the native population and the metabolism of several species of native animals and plants. Under the second director, George E. MacGinitie, life history studies of certain organisms and ecological investigations, especially of marine invertebrates, were undertaken. More recently, under the directorship of Dr. Ira L. Wiggins, the research program has broadened to include in addition to general biological surveys, work in crystallography of recent and older ice, magnetic storms, the aurora, thermal and other geophysical properties of the permafrost zone, paleontology, oceanography, and microclimatology.

"Accomplishments to date include a rather comprehensive knowledge of the flora, fauna and the climatic environment of the coastal plain, the fresh water lakes and lagoons, and of coastal marine waters of northern Alaska. Survival techniques for isolated personnel have been improved. Many new plants, animals and fish have been shown to be eatable and the vitamin content of many has been determined. Furthermore, the habits of the animals have been defined, and improved methods of snaring and trapping food animals have been developed.

"Investigations of the permafrost have been concerned with a number of fundamental geothermal problems: its depth, cold reserve,

depth to zero, annual temperature change, time variations in temperature change, and the effects of salt and fresh water, buildings, roads and other structures on these characteristics. Research on polygonal patterned ground has established the relationship between the size of polygons and the coefficient of thermal expansion of the ground. This makes possible an estimation of the amount of disturbance that might be expected in a given type of ground through a study of the polygons. . .

"Paleobotanical research reveals that the plant fossils of most of the foothill formations along the north slope of the Brooks Range indicate their age as Lower Cretaceous rather than Upper Cretaceous. Apparently the familiar problem of the Lower Cretaceous-Upper Cretaceous boundary in the Rocky Mountain Region extends to the Brooks Range of the Arctic."

In an official progress report on the ARL dated January 1, 1954 the Office of Naval Research summarized progress that had been made in several fields of scientific investigation in arctic Alaska through projects at or out of the Laboratory. The report pointed out the wide scope of research being supported at the ARL which "provides laboratory facilities and complete logistic support for scientists working under contracts with the Office of Naval Research and other government and military agencies". Among the accomplishments of the program, the report mentioned such varied items as:

"Research on the characteristics and physical properties of permafrost has provided a large amount of new information . . .

"New sonic data have been obtained from under solid-ice-covered water and open water, and on wind-produced under-ice noises. Studies on relation of underwater ambient noise to physical environment (temperature and salinity) have shown a definite correlation of sound level with ice conditions.

"A study of size and age composition of plankton near floes provides a reliable basis for determining the relative length of time since breakup . . . Related faunal studies indicate that there is a chain of organisms correlated with certain types and sizes of ice. This is particularly useful in preparing guides for survival and emergency procurement of food.

"Microclimatic observations and measurements have provided a substantial amount of new information on the characteristics and variations of climatic factors in the zone in which man operates, the zone from the ground up to six feet.

"Because this was essentially an unknown area from the biotic standpoint, a considerable amount of the initial research had to be concerned with inventory and survey. This type of study has now been completed . . . Studies of population dynamics among certain land mammals and among both fresh-water and marine fish have been made.

"Physiological studies have determined the metabolic rate of several terrestrial and aquatic animals at various temperatures . . . Measurement of oxygen consumption and respiratory quotients of buds

and roots of plants and lichens show easily measurable amounts of metabolic activity of plants hitherto considered metabolically dormant in the arctic winter.

"Changes in the historical climate have been traced through pollen analysis of varves and cores. Evidence from the Chandler Lake area . . . and from Bettles . . . indicates there has been a gradual warming but that the maximum temperatures were reached probably at about the same time as the post-glacial thermal maximum in Europe and eastern America, and that there has been a slight cooling since that time.

"Detailed inventory has confirmed the opinion that no fish in Alaskan waters are poisonous and all are edible if cooked . . . Experiment has shown that peat available along banks of rivers and shores of lakes is a useful fuel. It has been found that wet peat will burn."

In a summary paragraph the report pointed out that—"Among the accomplishments of the project it should be emphasized that the Arctic Research Laboratory, in its six years of operation, has brought to the Arctic approximately 175 scientists from some 27 universities, 7 federal bureaus and offices, and 5 institutions and foundations. Most of these scientists could not have worked effectively in the Arctic without the logistic support provided by this laboratory. The program of the laboratory has thus provided a continuously increasing cadre of scientists well acquainted with arctic environments and problems which will be of inestimable value in the planning of military operations."

The ONR report emphasized the extent of support supplied by the ARL to many other government-sponsored research projects developed by the Air Force, Navy, Coast and Geodetic Survey, National Park Service, Public Health Service, National Bureau of Standards, Weather Bureau and others.

The research program

The program in 1951

In his good-bye letter to the Advisory Board on July 31, 1950 the outgoing Scientific Director, George MacGinitie, inserted some parting advice. He wrote—"It seems to me that our greatest need is that the opportunities that are existing here for research be disseminated among the top scientific workers in the country. Perhaps you and the Board can figure out some way of doing this." At its next meeting in November, 1950 the Board discussed the problem of expanding the research program at ARL. After listening to Dr. Wiggins' report of the worthwhile results he had achieved already in this direction, the Board recommended that he spend a large part of the fall and winter months in the States developing interest in the Laboratory among scientists.

Results were gratifying. Fourteen research projects were proposed at the next Board Meeting in January 1951 and were recommended for adoption by ONR. It was noteworthy that the 1951 research program was larger, more varied, and more carefully weighed before its adoption

than previous ARL programs. This favorable beginning under the new Scientific Director proved not to be a flash-in-the-pan, but a continuing characteristic of that period in ARL history. The Executive Committee of the Advisory Board which met on November 21, 1950 agreed that one of the important functions of the Scientific Director and of the members of the ARLAB should be the presentation to qualified investigators of the opportunities for scientific work at the Point Barrow laboratory. The results of the efforts subsequently expended were significant, not only in the development of research projects at ARL, but in developing interest in arctic investigations in the scientific community on a much broader front than before.

Dr. Wiggins took over the direction at the Laboratory as Acting Scientific Director as the 1950 summer program was coming to a close. After the departure of the summer investigators, three teams remained to carry on over the winter months. Dr. Wiggins' own project, Ecological and Taxonomic Investigation of the Vascular Plants in the Vicinity of Point Barrow, made progress despite the Director's absence for a long period and his necessary emphasis on lining up projects for the 1951 program.

The permafrost investigations, operating on a year-round basis, were picked up in September, 1950 by Max J. Brewer and R. F. Black of the U. S. Geological Survey, replacing G. R. MacCarthy who had to

return to the States. Installation of thermistor cables at various sites, including some as far from Barrow as Umiat, continued all winter. Problems of broken cables and erratic performance of the reading mechanisms in extremely low temperatures were encountered, but these, plus the more usual arctic problems of winter operation, did not prevent the collection of many new data on permafrost depths at different locations and under different topographic or other conditions.

Mr. and Mrs. J. B. Wickham, of the Scripps Institution of Oceanography, continued their collection of field data by ice sampling and analysis in their investigation of Oceanographic Currents and Sea-Surface-Atmospheric Relations. Ice samples, as in the previous winter, were analyzed for density, chlorinity, and conductivity. Thin sections were prepared for photoanalysis. As was to be expected, problems arose in trying to move on the rough off-shore ice and sled trails had to be hacked out where the ice was too rough to permit passage by mechanized vehicles.

During the spring of 1951 two investigating teams, not under ONR auspices, arrived at ARL, completed their field work and departed. One of these was Project Ski Jump, involving tests of landing aircraft on sea ice and making off-shore oceanographic observations through the ice. The team consisted of John F. Holmes and L. V. Worthington of the Woods Hole Oceanographic Institution and eight Navy personnel.

The 1951 ONR files reflect some formal and much more informal correspondence of a three-cornered type between Harry Balvin, Assistant

to the Director at Point Barrow, Ira Wiggins at Stanford, and ONR in Washington prior to the arrival of the Ski Jump party in northern Alaska. It is clear from the correspondence that the ARL was mainly concerned that everyone who eventually would be operationally involved should be kept fully informed at all stages of planning in order to avoid later problems. ARL was particularly concerned that the Ski Jump planners make arrangements for the aviation gasoline that would be required, as well as for other special requirements that could not be met at Point Barrow after arrival there. The record indicates that the 1951 Ski Jump group had been the source of some problems. This became clearly evident to Washington later in the year when plans were being made for Ski Jump II.

Logistical support by ARL was also given to Jack E. Oliver and Robert Cotell of the Air Force Cambridge Research Laboratories, who completed a brief assignment obtaining data on tides, seismology, and related subjects.

At the end of May, 1951 Mr. Everett Schiller, Assistant Parasitologist with the U. S. Public Health Service, Anchorage, Alaska, arrived at ARL for a two-week stay continuing investigation of parasites found in native birds and mammals of Alaska. That project, under the direction of Dr. Robert Rausch of the USPHS, was especially concerned with parasites which are a health menace to humans through consumption of native game animals, water, or other foods. Skin tests given to natives along

the arctic coast indicated, for example, that about 25 percent of the adult population gave positive trichinosis reactions. The investigation suggested the probability that trichinosis is responsible in the arctic area for considerable morbidity and mortality incorrectly ascribed to typhoid and other gastro-intestinal disorders.

The summer investigators, as was customary, began arriving in early June 1951, and from then on the scientific as well as other activity at the Laboratory stepped up rapidly. Dr. Wiggins' own project of investigating vascular plants in the vicinity of Point Barrow continued, aided by the arrival of Kenton Chambers, who devoted most of his time to collecting material in the outlying parts of Naval Petroleum Reserve No. 4.

Another project which picked up from the previous year was the study of Life History and Ecology of Lemmings by Dr. Daniel Thompson and his assistants from the University of Missouri. That investigation, begun in 1950, continued for five summers and eventually was completed in August 1954. By observation and controlled experiments of many kinds the researchers gathered data on lemming ecology, permitting comparison of Alaska lemmings and those of other areas such as Norway. In his seminar lecture at the Laboratory in July 1953, Dr. Thompson was able to contrast the periodic concentrated movement of lemmings on the coast of Norway with the absence of such concentrated movement at Barrow, where, he said, one rarely could get two animals in the finder

of a camera at one time. He attributed this difference to the terrain factors which produce concentration in Norway but permit dispersal at Barrow.

The summer of 1951 also was a noteworthy one at ARL in that six other research projects got underway, all of which continued for at least three summers and therefore coincided roughly with the administration of Ira Wiggins. They included research on the flora and fauna of the region as follows:

1. A Survey of the Fishes of Alaska with Particular Reference to Those of Importance to the Military and Naval Services, with Stanford University investigators under the leadership of Professor Norman J. Wilimovsky. In the 1951 season he was assisted by James E. Bohlke; in 1952 by H. Adair Fehlman and Mrs. Diana Wilimovsky; and in 1953 by Mr. Fehlman and Dr. John Greenbank.

2. Investigation of the Geographical Distribution of Mosses and Liverworts in Northern Alaska, with Stanford University investigator, Dr. William C. Steere, in charge. In 1951 and 1952 he was assisted by his wife, Dorothy O. Steere; in 1953 he was assisted by Dr. Howard A. Crum.

3. Biological and Taxonomic Survey of Freshwater Algae and Associated Plants in Northern Alaska, a Michigan State College study led by Dr. Gerald W. Prescott. During the 1951 season he was assisted by

George Lauff and William C. Vinyard; in 1952 by Robert Haubrich and John Koranda. In 1953 Mr. Koranda completed the field work alone.

4. The Life History of Certain Small Arctic Mammals (Barrow Ground Squirrel), an investigation led by Dr. William V. Mayer, University of Southern California, assisted in the summer of 1952 by Roy G. Robinson, Jr. and Edward T. Roche. The 1953 field research was done by Edward Roche and James Northern.

5. Archaeological Survey of the Eskimo, or Earlier Material in the Vicinity of Point Barrow, a project of the Peabody Museum, of Harvard University, under the direction of Dr. J. O. Brew. The field investigations in 1951 were carried on by Mr. Wilbert K. Carter, Charles L. Shade, H. Thomas Cain, and Robert W. Tanner. In 1952 Mr. Carter was accompanied by his wife, Mrs. Thelma Carter, by Mr. William R. Bullard, Jr., Mr. William L. Kashube, and Mr. Theodore L. Stoddard, Jr. The 1953 summer field party included Mr. and Mrs. Carter, Mr. Jordan Douglas, Mr. Henry Nicholson, and Dr. James A. Ford of the American Museum of Natural History.

6. Population Biology of Arctic Land Vertebrates, a University of California (Berkeley) project led by Dr. Frank A. Pitelka. Field research in the summer of 1951 was done by Dr. Pitelka, Mr. Gilbert S. Greenwald, and Mr. Henry E. Childs. The 1952 field party, also led by Dr. Pitelka, included Dr. Paul Hurd, Mr. Keith L. Dixon, and Mr. George Treichel.

In 1953 Drs. Pitelka and Hurd were accompanied by Mr. Quentin F. Tomich and Mr. William L. Thompson.

In addition to Dr. Wiggins' own research project, which continued through 1951 and on into 1952, two other projects which spanned at least two seasons were:

1. Manual of Native Land Mammals of Northern Alaska, a University of Kansas project led by Dr. E. R. Hall. The Point Barrow field party in 1951 was James W. Bee and J. Knox Jones, Jr. The 1952 investigations were made by Mr. Bee and Mr. Edward G. Campbell, joined in August by Dr. Hall.

2. Post Glacial History of Point Barrow Region and Relevant Studies of Aquatic Ecology, a Yale University project under the leadership of Dr. Edward S. Deevey, Jr. The 1951 summer field party was led by Mr. Daniel A. Livingstone, and assisted by Mr. Kirk Bryan, Jr. In 1952 Mr. Livingstone was accompanied by Mr. R. G. Leahy. The project by 1952 had been re-titled Biostratonomy of Arctic Lakes.

In July 1951 Gabriel W. Comita and Robert A. Main of the University of Washington arrived at ARL to begin a two-season research project on Limnology of Alaskan Lakes. Investigations and samplings in local lakes continued into September 1951 and were resumed the following July. Mrs. Jean J. Comita assisted her husband in the 1952 field investigations which terminated on September 22, 1952.

Four projects which had investigators stationed at ARL in 1951 completed their field work in the Point Barrow area in the one summer season:

1. The Academy of Natural Sciences of Philadelphia, with Dr. Ruth Patrick as Principal Investigator, sent Dr. Leonard R. Freese to make a study of the Diatom Flora of the Lakes in the Vicinity of Point Barrow. During the June-August period he took nearly 170 diatom samples, including several from the Arctic Ocean.

2. A team of three investigators from the University of Michigan, consisting of Dr. Chester A. Arnold, John S. Lowther, and Richard A. Scott, spent July and August 1951 in productive search along the Colville River, mainly out of Umiat, and made an extensive collection of fossil plants. They also found numerous coal outcrops above the mouth of the Awuna River. The project was officially titled Paleobotanical Research in Alaska.

3. Dr. Paul D. Voth of the University of Chicago was at ARL in the summer of 1951 conducting field research on the Biology of Marchantia Pylomorpha and Associated Plants in the Alaskan Arctic. He departed for Chicago in August with a collection which would enable him to do further study of living and pressed arctic plants at the university.

4. On August 21, 1951 Dr. F. G. Gustafson from the University of Michigan arrived at ARL for a project on Vitamin Analysis of Arctic Plants.

After collecting specimens which were quick-dried at the Laboratory, he departed with his sampler on September 11. The collected samples were to be analyzed for the four vitamins, ascorbic acid, thiamine, riboflavin, and niacin during the ensuing winter months.

Another investigator who was at ARL in 1951, but did not return later was Henry W. Setzer from the Smithsonian Institution. As a result of a complex of unfortunate circumstances and developments, two essentially identical projects, both on land mammals of northern Alaska, were scheduled. The other was a project of Professor Hall of the University of Kansas and was led by James Bee. The results were unhappy, and eventually Dr. Setzer turned over his collection to Professor Hall and did not return for any further investigation.

The program in 1952

The year 1952 was a very busy one at the ARL, kicked off early in the year by the arrival of Ski Jump II in February. Preparation for Ski Jump II had been going on for several months, and Dr. Wiggins and Harry Balvin had carried on extensive correspondence with ONR in an attempt to prepare themselves and others who would be involved in the operation when it would get underway in Alaska. Among the numerous problems that arose, two were subjects of headscratching, frustration, irritation, and amusement in a variety of mixtures. One involved the demands made on ARL for storage batteries, which the Laboratory did

not have, a fact of which Dr. Wiggins had earlier warned Ski Jump planners, and the arrival of some 50 carrier pigeons which were sent to ARL to serve as auxiliary and possibly emergency means of communication between ARL and Ski-Jump activities. The carrier-pigeon operation was based on previous antarctic trials, but was not successful at Point Barrow. When the birds were released, some froze to death, others disappeared, probably with the same result, and in any case pigeon care and feeding became a trial to the ARL staff, inexperienced in pigeon care.

The large Ski Jump II party departed from the ARL on April 26. The summer investigators began arriving in May. Ten of the summer projects were continuations from the summer before. Eight new projects were scheduled and all were performed. Included were:

1. Birds of the Colville River Drainage, under the sponsorship of the University of Alaska (Dr. Brina Kessel) was carried on in the field investigations by Tom Cade and George Schaller. They travelled by canoe down the Colville River from the Etivluk to Umiat, collecting a considerable number of birds en route.

2. Population Dynamics of Isolated Unexploited Fish Populations, a Stanford University project, was under the field direction of Dr. Donald E. Wohlschlag assisted by Daniel M. Cohen. They made reconnaissance trips in June and working through July and August, seined fish, mainly from a small lake near Barrow.

3. Terrestrial Arthropoda of Northwestern Alaska, a Yale University investigation, was begun in June as a general survey of the insects of Naval Petroleum Reserve No. 4. The field investigators were Drs. Peter F. Bellinger and G. W. Rawson. The non-resident principal investigator was Dr. Charles L. Remington. The paucity of bees and the large number of flies working over flowers were noted. Collections were returned to Yale for further study.

4. Ecology of Arctic Crustaceans, a University of Southern California project, was investigated by Dr. John Luther Mohr and Charles Horvath. Both fresh-water and marine samples were collected during July and August and packed for return to the University. In July 1953 a return party arrived at the ARL to continue the investigation. That time Dr. Mohr and Charles Horvath were accompanied by Dr. Jerry L. Barnard and Dr. D. L. Reish. The 1953 investigations made use of data that had been gained by other researchers.

5. Littoral Sediments of the Point Barrow Area, a project arranged by ONR with Stanford University, was directed by Dr. Siemon W. Muller. The field investigations were made by Robert W. Rex and Edward J. Taylor, who arrived at the ARL on June 4th and remained actively at work until their departure on August 27th. Although the project was recommended by the ARLAB for continued operation in 1953, the researchers did not return to the ARL until 1954.

6. Archaeological Reconnaissance of the Lower Colville River, a University of Alaska project, was made by William N. Irving (son of the first Scientific Director of the ARL) during the June-August period.

7. During the summer a Northwestern University project was carried on under the direction of Dr. Max E. Britton, assisted by Arthur Scharf. They studied Reciprocal Relationships of the Physical Environment and Vegetation of the Alaska Tundra. The field work involved the installation of a network of thermograph stations as well as of maximum-minimum thermometer stations. Collections were made of numerous plant species and an herbarium was prepared. During the summer plans were completed for the winter operation of the microclimatic phases of the project and William Howard Craig from UCLA arrived at the ARL on September 20 for a year's stay. In June 1953 Dr. Britton returned to the ARL. Dr. Jack Major of Northwestern University also arrived and Dr. Paul Hurd, University of California, already in residence, joined the Britton party. At the end of the summer all insect collections were sent to Dr. Hurd's laboratory in Berkeley, and the field data and the instruments were returned to Northwestern University.

8. On June 21 another investigating team, Dr. and Mrs. Robert Spencer of the University of Minnesota, arrived at the ARL to begin their researches on the Human Ecology of the Alaskan Slope. The Spencers were able to find quarters in Barrow village and devoted the summer to a

study of the culture, pre-contact and contemporary, of the Eskimos. The next summer the Spencers extended their investigations to other communities, giving attention to both the coastal and inland cultures. Several days were spent at Anaktuvuk Pass studying the migratory Eskimos of that region. The researchers compared the cultures of the nomadic inland with the maritime Eskimos. At the end of the 1953 summer season the Spencers boarded the S. S. North Star of the Bureau of Indian Affairs for a coastal trip which brought them into direct contact with the Eskimos of other villages, including Wainwright, Point Lay, and Point Hope.

During the summer of 1952 the ARL supplied greater or lesser logistic support to a number of investigators whose presence in northern Alaska was not arranged by contract with the Office of Naval Research. Those researchers included Dr. J. Louis Giddings, an archaeologist of the University of Pennsylvania, and his assistant Alex F. Ricciardelli; Dr. Lyman Benson, Pomona College, sponsored by the Arctic Institute of North America in A Study of the Genus *Ranunculus* in the American Arctic and Subarctic; Dr. A. Starker Leopold and Dr. Fraser Darling of the Conservation Foundation making A Survey of the Wild Life Resources in Alaska; George Collins and Lowell Sumner of the National Park Service making a Biological Survey of the Mount Michelson-Kongakut River Area; Max C. Brewer, James W. Knox and S. J. Odend'hal continuing their Permafrost Project for the U. S. Geological Survey; and Mr. Elwood Maple

and Raymond Harwell from the Naval Ordnance Laboratory who arrived on September 3 to work on a magnetic-field measurements project.

Limited logistic support was also extended to eight oceanographers from the University of Washington, two representatives of the Air Force Cambridge Research Laboratories, and to Messrs. Ross and Ferrari of the U. S. Coast and Geodetic Survey. Equipment was loaned to investigators aboard a U. S. Navy vessel during August.

During the winter season 1952-1953 the research program at the ARL under Office of Naval Research sponsorship again dwindled as the summer investigators departed for the South. Work continued on Director Wiggins' own project and on Max Britton's Northwestern University project. The permafrost studies under Max Brewer also continued, and the Laboratory played host and gave extensive logistic support to other field projects. The Air Force Cambridge Research Laboratories sent J. D. Lynch and S. Wolnik to the ARL in February 1953 for a short stay. A classified project sponsored by the Lincoln Laboratory and carried out by a group from the Massachusetts Institute of Technology, called Project Moby, started in November 1952 and continued until the next March. Investigators included Harry Schechter, A. L. Cudworth, W. G. Metcalf, and D. A. Rogers. The investigators departed in March 1953 leaving much gear to be packed and shipped after them.

The program in 1953

At its twelfth meeting the ARLAB approved sixteen research proposals for the 1953 season. Ten of them would be carryovers from 1952 or earlier and six would be new programs. Director Ira Wiggins reported that many of his scientific colleagues and many of their former students were excited by the possibility of doing arctic research. Before the 1953 summer program got underway the Navy announced the termination of the Pet 4 project. The final meeting of the ARLAB was held in Washington on April 13, 1953, at which time the 1953 program was already pretty well lined up and was endorsed, with revisions mainly in the administrative arrangements for financial support. The Board expressed itself as being strongly in favor of continued arctic research.

The spring and summer of 1953, therefore, became a very busy one at the ARL in planning for the Laboratory itself, possibly without Pet 4 support, and providing support for a full research program.

The first to arrive at the ARL to begin the summer research program were Daniel Q. Thompson of the University of Missouri, there for his fourth summer, and Dr. Frank Pitelka of the University of California, accompanied by Quentin Tomich. Among the researchers appearing at the ARL for the first time was the team of Dr. Paul A. Baldwin and Edward B. Reed of Colorado A. & M. College to study Breeding Ecology and Physiological Rhythms of Some Arctic Birds at Umiat, Alaska.

During the June-August period hundreds of specimen birds were collected, others banded and released, and many more examined. Feeding sources and habits also were observed.

A second project was a Geographic Survey of the Kongakut-Firth River Area in which National Park Service, Geological Survey, and University of Pennsylvania investigators participated. Surveys were made in three fields; biogeographical, geological, and archaeological. The investigators were Lowell Sumner, Marvin Mangus, William G. Carnes, and Alex Ricciardelli. George Collins and Lowell Sumner had initiated the project the previous summer for the National Park Service. The researchers encountered transportation and supply problems because of fog and rain, as well as cascades and rapids in the rivers. Nevertheless, the research was productive in all fields except the archaeological, in which results were disappointing. "The most outstanding success was in locating a herd of approximately 26,500 caribou" reported Lowell Sumner in his summary of the accomplishments of the biogeographical study.

On June 20 the team of William L. Quaide and Robert Fladeland from the University of California arrived at the ARL to begin their Enquiry into the Paleontological and Geological History of the Naval Petroleum Reserve No. 4. Reuben Stirton was the principal investigator. Extensive field investigations, principally along river beds, produced many fossil remains,

including those of horse, musk ox, caribou, and mastodon fossils.

Geological mapping was also accomplished in the Avalik and Kaolak river areas.

During July and August a team of investigators from the Colorado School of Mines was at the ARL working off the coast near Barrow on the Ecology of the Foraminifera in the Vicinity of Point Barrow, Alaska. Dr. W. D. Mateer was the leader of the team which included Alan Akers and Raymond Kella. Dr. Mateer reported that, "Time, limitations of transportation, failure of some equipment to work under Arctic conditions and the constant hazard of Arctic weather interfered, and in several cases prevented, the completion of the project as it was originally visualized, but through the excellent cooperation of the management of the ARL and several of the contractors on other projects, sufficient data were collected for a good beginning on the project."

Dr. Chester A. Arnold of the University of Michigan, who had been at the ARL in the summer of 1951, with J. S. Lowther and R. A. Scott, did not himself return but sent the team of J. S. Lowther and W. J. Maher to continue work on Paleobotanical Research in Northern Alaska. Explorations were conducted in the Meade, Utukok, Kuk, Avalik, and Kaolak river areas and the vicinity of Wainwright. Numerous fossil specimens were collected, including mineralized wood and coal, and ferns and conifers.

In addition to the investigative teams mentioned above, the ARL also was host to Dr. Robert Rausch of the Arctic Health Research Center, U. S. Public Health Service, Anchorage, who collected additional materials for his parasitological studies and also secured the cooperation of Alfred Hopson, an inhabitant of Barrow Village, in translating into Eskimo a paper on parasites in arctic food mammals. It was hoped that the issuance of a bulletin on that subject would be of value in reducing infection of humans by common parasites of mammals in the arctic areas.

For ten days in June 1953 the ARL was visited by Reid Bryson of the University of Wisconsin who was being sent to Point Barrow by The Johns Hopkins University in order to test his new instrument for measuring reflectivity of radiation from the surface of the tundra. The project was part of An Estimate of the Heat Budget of the Lower Atmosphere at Point Barrow, Alaska (Summer) and involved evaluation of radiation and soil-heat storage. The project was closely related to observations being carried out by Dr. Max Britton and his assistants who could supply continuing data for the later analysis.

A summer project which had been approved for the 1953 season but did not in fact materialize was a further investigation by Dr. L. R. Freese of the Academy of Natural Sciences of Philadelphia into the Diatom Flora of the Arctic Ocean.

With the close of the 1953 summer season Dr. Ira Wiggins departed from the ARL, but continued as Scientific Director for the remainder of

the calendar year. With the closeout of the Pet 4 project and the termination of logistic support from BUDOCKS through the Arctic Contractors, the installations at Point Barrow were greatly consolidated and brought under direct ARL supervision. The September-December period did not shut down research activity, however.

Charles Matthews and John Merrick of the U. S. Air Force and Boston University continued their observations under the Keys Project, a classified operation. The ARL furnished logistic support. Also supported was a U. S. Air Force and National Bureau of Standards project on Communications Problems. The investigators were J. A. Kemper, A. F. Daly and R. G. Long.

Working out of the ARL, Richard Green of the U. S. Coast and Geodetic Survey continued operation of the Magnetic Observatory through the fall and winter months. The Arctic Ice and Permafrost Studies under Max Brewer, assisted by Arthur H. Lachenbruch, Edith Lachenbruch, William J. Maher, and S. J. Odend'hal, remained hard at work throughout the same period, with Brewer taking time out in December to attend conferences in Washington and other cities.

Back in the States Dr. Wiggins carried on a heavy schedule of correspondence with prospective investigators for the 1954 ARL season. Proposals were submitted to the Arctic Institute of North America and through them, to the Office of Naval Research. By the end of November

he found that there were more proposals for research contracts for 1954 than could be accommodated at the ARL. He also reported that "very generous offers" to assist in formulating an operational and research program at the ARL were made by the Lamont Geological Laboratory of Columbia University, whose representatives had been alarmed by rumors that the ARL soon would close completely.

The Home Office Has Many Problems

By official ONR letter dated September 1, 1950 Dr. Wiggins was assigned authority to perform the functions that in effect made him legally the Scientific Director. Curiously, the letter does not use the word "director" or "Scientific Director". It simply authorizes Dr. Wiggins to perform certain administrative and related functions in addition to those of Principal Investigator of his own project.

Almost immediately a number of administrative problems arose, and ONR had to straighten them out by dealing, mostly through Mrs. Yvonne Reamy, Secretary of the ARLAB, with the SDARL and with The Johns Hopkins University. Although Dr. Wiggins was an experienced researcher at the ARL, he had not previously had the prime responsibility for operational matters that he now held. The problems were of the usual kinds ---mostly selection, authorization, and security clearance of persons going to the ARL; and travel problems, especially since military transportation was in very scarce supply and unreliable as to timing, orders, and priorities.

The ARLAB received two letters, both dated in August 1950. from former researchers at the ARL, and one a former SDARL, complaining bitterly of alleged policies of ONR in regard to support of researchers after field work is completed until the publication of results. The letters were referred for attention to ONR. All comments, however, were not

critical as witness a portion of a letter to ONR dated September 2, 1950 from a scientist on his return to his home institution.

"Despite the fact that the Korean War interfered with the normal schedule of flights to and in Alaska and restricted the areas which could be reached before the end of the summer vegetation season, the trip was highly successful from a research standpoint. This was due to the fact that at Point Barrow and adjacent areas of the United States Navy Oil Reserve the materials for study were even better than had been anticipated. Not only were all the expected species of *Ranunculus* available for field population studies but also unexpected species provided the key for solution of problems which I had not supposed could be studied in Alaska. The Acting Director of the Arctic Research Laboratory, under contract with the Office of Naval Research, Dr. Ira L. Wiggins, was very helpful not only in making available transportation by means of 'weasel' to inland portions of the tundra but also through materials which he himself had prepared for me earlier in the summer.

"I wish to express my appreciation as well as that of Pomona College and the Arctic Institute of North America to the United States Navy and the Office of Naval Research both for transportation and for the many courtesies extended to me by naval personnel, airforce personnel, and the Director and staff of the Arctic Research Laboratory."

Another incident of interest is recorded in a letter of December 5, 1950 that RADM T. A. Solberg, CNR, was able to write to Dr. Luther Evans, Librarian of Congress.

"As is well known, a towering figure in recent American Arctic history, especially on the Alaska scene, was Charles Brower, who was instrumental in aiding many scientific expeditions in the region, although he himself was a trader.

"During a recent trip to Alaska, one of the members of the staff of the Office of Naval Research came across Charles Brower's diary, which his sons, David and Tom Brower of Point Barrow, Alaska, graciously made available. They indicated a willingness to allow the Library of Congress to retain this diary. In the desire to stimulate interest in the Arctic, and in the belief that his document is of real value to the serious studies of the Arctic, this office takes pleasure in presenting the Diary of Charles Brower to the Library of Congress."

Of much greater concern and of much more fundamental importance were the continuing problems of organization and administrative patterns. An alternate member of the ARLAB, Assistant Secretary of the Smithsonian Institution, John E. Graf, commented on these matters in a long letter to the Chairman of the ARLAB dated August 15, 1950. He felt that the SDARL should have a full-time assistant director. He also felt that the responsibilities of the SDARL needed clarification especially in regard

to projects supported logistically by the ARL but for which the SDARL had no technical responsibility. These were largely military projects, some highly classified.

The operating contractor, The Johns Hopkins University, was concerned because it felt that it did not have enough freedom of action and authority for decision. ONR was not satisfied completely with the service being rendered by the University. Also ONR felt that the ARLAB was really not performing its functions satisfactorily. Thus arose the suggestion, probably first in ONR, that perhaps the Arctic Institute of North America would be a more deeply interested contractor than the University. This triggered quite a storm and sometimes from unexpected quarters.

Dr. MacGinitie, former SDARL, wrote in September to the Secretary of the ARLAB that he thought the AINA was the organization that should have the operating contract. He cited the lack of real arctic interest at The Johns Hopkins and the failure of its local advisory committee. However, he did have some concern about the ability of AINA to do the job.

Mrs. Reamy, the ARLAB Secretary, wrote at length to the SDARL on these matters on October 6, 1950. She felt that if the University decided to propose a continuation of the contract, it would insist on some conditions that just could not be met by ONR. She also expressed some concern about the capacity of the AINA to take over, but felt that with proper support it could deliver a creditable job.

On October 9, The Provost of The Johns Hopkins University, Mr. P. Stewart Macaulay, wrote at length to Dr. John Field in ONR and set down the various points that were of concern to the University in regard to the operation of the ARL. In brief, he felt—

1. That the contracting institution should have full responsibility.
2. That any advisory board should be selected by the University and be responsible to it.
3. That the SDARL should be responsible to the University only.
4. That the SDARL should be charged with the development of the research program.
5. That the SDARL should set up an integrated program and then find the people to staff it.

After being informed of the contents of Mr. Macaulay's letter, the SDARL wrote ONR on October 18 pointing out his views on these administrative matters and generally agreeing with the position of ONR rather than that of the University. However, he was skeptical of the capability of the Arctic Institute to take over the contract.

About this time, late October 1950, the President of The Johns Hopkins University, Dr. Detlev Bronk, heard reports to the effect that there was some dissatisfaction with the way the ARL contract was operating and that AINA had been suggested as an appropriate contractor. He apparently felt that full information had not been given to him. He is

said to have remarked—"To be frank, I am a little bit raw on these arctic things at the moment. If this arctic thing is going to bog down to sniping and less than frank statements this whole thing will fall flat."

Also in the file is a seven-page statement, with no author or addressee indicated but dated October 1950, that is made up of two parts—one entitled "Arctic Research Laboratory" and the other "Arctic Research Laboratory Advisory Board". The first part discusses the scarcity of real arctic interest at The Johns Hopkins University and suggests the Arctic Institute as an appropriate contractor, which should establish an office in Washington. The second part suggests a reorganization of the Advisory Board with membership to be held by active arctic scientists and the operation of the Board to be by the AINA.

It is not surprising that in regard to financial matters Dr. Wiggins needed to be indoctrinated in order to grasp adequately a rather complicated pattern. The Secretary of the ARLAB, Mrs. Reamy, wrote the SDARL a long memorandum on September 6 that outlined the situation and which was greatly appreciated by the SDARL. She pointed out that at the beginning of each fiscal year the Assistant Chief of Naval Research makes available to the Biology Branch funds for,

1. The maintenance contract, at that time held by The Johns Hopkins University;
2. Logistic support—to BUDOCKS for expenditure under the oil-exploration program;

3. The operation of the Advisory Board—to the Smithsonian Institution.

The items listed are exclusive of contracts or grants in support of specific research projects. Incidentally, the estimated cost of item 1 above for fiscal year 1951 (July 1, 1950 - June 30, 1951) was about \$83,000. Item 2 was about \$100,000—\$16,500 for air support and \$84,000 for other logistic support. The other logistic support included such items as materials and supplies, messing and billeting, shop, labor, arctic gear and clothing, equipment, and use and upkeep of buildings.

In the same memorandum Mrs. Reamy explained that the investigations at the ARL included three types:

1. Investigations under contract with the ONR;
2. Investigations by other government agencies, such as other bureaus of the Navy, the Geological Survey, the Coast and Geodetic Survey, etc.;
3. Investigations paid for by others but given house room and logistic support by the ARL, like the AINA.

Financial affairs can become complex even when the established pattern seems simple and straightforward. A good example is the maneuvering in regard to completing Building 251 for the ARL. Dr. Wiggins was in the saddle when the building was completed, but the plan for it and

most of the work, had long been the concern of his predecessor, Dr. MacGinitie. In mid-September 1950 Mrs. Reamy explained that the original estimate to convert Building 251 to ARL use had been \$42,000. This was then scaled down because Dr. MacGinitie felt that a good deal of the inside finishing could be done by his own ARL Eskimos. Then it appeared that any work over \$30,000 would have to be submitted for review to the Research and Development Board. Also the work would have to be inspected by regular ONR personnel. Therefore, the estimate was scaled down to \$29,000 in order to stay within the \$30,000. The \$29,000 was then made up of \$24,000 not needed in the Johns Hopkins contract, which was authorized for use by BUDOCKS plus the \$5,000 additional in new money. However, this authorization to BUDOCKS made it impossible to use the money for any other purpose without additional authorization.

During 1951 there was a great deal of discussion of the project organization within ONR for the administration of the arctic program, which was almost entirely the program of the ARL. A hint of what was to follow appeared as early as January in a memorandum prepared by Mrs. Reamy. She said that the Arctic Research Laboratory Project (Code 407) would soon be a full-fledged branch with its own financing. It was anticipated that the funding for fiscal year 1952 (Starting July 1, 1951) would include \$125,000 for research and \$175,000 for logistics and operations.

By mid-April the thinking had progressed and Mrs. Reamy outlined in a memorandum to the SDARL the history of the organization of the

arctic program in ONR and the status of thinking. She pointed out that originally the ARL project was part of the Ecology Branch in the Biological Sciences Division. Later the Ecology Branch was changed to the Biology Branch. As the ARL program was changed to include more and more research in the earth sciences, the project was moved up above the divisions into the general administrative part of ONR. The thought was that this would broaden the interest in the ARL throughout ONR.

However, the major interest still remained in the Earth Sciences and Biological Science Divisions and the interest of the latter seemed to be waning. The plan was, as of mid-April, for the two Division Chiefs to meet and decide where the project should be placed. In the Geophysics Branch of the Earth Sciences Division was thought to be a likely spot. By this time it was known that Dr. John Field would be leaving ONR sometime in June 1951.

The SDARL felt that the ARL was likely to suffer in all the juggling that was going on, and at the end of May he wrote to Dr. T. J. Killian of ONR pointing out the inconsistency of placing the program in any branch or division because the program spanned many disciplines. His argument was effective, and a week later Mrs. Reamy was able to report that a compromise was likely whereby the ARL project would be placed in the Geography Branch of the Earth Sciences Division, but would have its own budget and be directed by a special Arctic Officer.

On July 24 a memorandum was sent to all members of the ARLAB detailing the changes that had been made. That memorandum contained the following—"Code 407 has been dissolved and is being replaced by Code 414C. This code comes organizationally within the Geography Branch of the Earth Sciences Division . . . the Project is not envisioned as being limited to the interests of that Branch . . . it is considered an independent Project, not a subordinate section under the Geography Branch . . . Efforts are being made at this time to find a person to fill the billet as Head of the Project. Dr. Louis O. Quam, Head, Geography Branch, will act in that capacity in the interim."

The same day, July 24, Dr. Quam requested all division directors who wished to designate a representative to serve on an ONR committee "to encourage participation of other scientific branches in the program of the ARL" and to advise in developing a coordinated program. The SDARL was concerned about some of the aspects of the new plan, especially the new committee within the ONR and the relation of that committee to the programming responsibilities of the SDARL and the ARLAB.

A little later, near the end of August, he had developed also some concern over the space available at the ARL, the assignment of priorities for the use of that space, the cost of supplying logistic support to projects of other government agencies, and the complicated organizational structure involving Code 414C, The John Hopkins University, the SDARL, and the ARLAB.

The year 1951 started under the threat of termination of the oil exploration in northern Alaska and what might be done to continue the ARL in that event. At about the end of January, ONR was pleased to learn that Captain R. H. Meade, the Director of Naval Petroleum Reserves (DNPR) would take the lead in appraising the interests of various government agencies in keeping the Barrow facility open and in sharing the cost. The Bureau of Standards and the Arctic Test Station of BUDOCKS were considered hopeful possibilities in addition to the ARL.

True to his agreement, Captain Meade called a meeting on February 16 to discuss the continuation. There were representatives, among others, from the Office of Naval Petroleum Reserves, Arctic Contractors, CNO, Coast and Geodetic Survey, BUDOCKS, Geological Survey, Weather Bureau, CAA, Bureau of Indian Affairs, USAF, Bureau of Standards, and Office of Naval Research. In view of the estimated annual cost of about \$655,000 and the need for 56 people to keep the facilities operating, most of the representatives were skittish about making commitments, and nearly all stalled as to just what their participation might be.

By the end of July the situation had changed markedly, and Captain Meade was able to inform the attendees of the February 16 meeting that the Navy had decided, after discussion with the Chairman of the Armed Services Committee of the House of Representatives, that the oil-exploration program would be continued on a year-to-year basis as may

be justified by the results obtained. Thus the specter of immediate closing receded for a time.

On December 18, 1952 the CNO wrote all appropriate units of the Navy Department pointing out that in 1948 had been promulgated a Naval Policy for Arctic and Cold Weather Planning, Training and Operations as well as a general Supporting Plan and a Program for prosecuting the policy. There was a short term (5-year) program, an intermediate (5-10 year) program, and long term (beyond 10 years) program. The memorandum pointed out that the 5-year program would be terminating in 1953 and stated that it was essential to formulate a new 5-year plan "for guiding and coordinating matters pertaining to the improvement of naval capabilities in the arctic and cold-weather areas." Addressees were requested to submit recommendations for inclusion in the new 5-year plan that would run until 1958. ONR was an addressee.

On December 23, 1952 the CNR reported to CNO on cold-weather projects supported by ONR. The Earth Sciences Division operated six such projects. The Physical Sciences and Psychological Sciences each reported one project.

About the end of March 1952, Mrs. Yvonne Reamy, who had served the ARL long and well, resigned to accept a position with the National Science Foundation. She was replaced by Miss Grace Stewart. Also about the first of April the Chairman of the ARLAB put in two weeks'

training duty as a Naval Reserve Officer in ONR and on that tour prepared an 8-page document that reviewed in some detail the organization and administration of the ARL, its programs, and its relationships with other organizations. That review, and the recommendations that it contained received concurrence, in most respects, by the SDARL and the ONR.

About mid-July 1952 there seemed to be substantial doubt as to whether or not The Johns Hopkins University wished to continue as the contractor for the administration of the ARL. In a letter dated July 10 to the SDARL, Dr. Quam, the Head of the Arctic Research Laboratory Project in ONR, wrote that if JHU decided against continuation of the contract after January 1, 1953, he would start inquiring as to the interest of the Arctic Institute of North America in taking over. The word apparently began to get around because on July 29, 1952, the President of the University of Alaska, Dr. Terris Moore, indicated the interest of his university in being considered. A little later, on August 21, a similar inquiry was made by John W. Marr, The Director of the Institute of Arctic and Alpine Ecology of the University of Colorado.

During that interval, there was a good deal of discussion about whether or not NSF would pick up the biological part of the ARL program. Some of those discussions were distressing to the SDARL when he learned of them as he feared a disastrous diminution of program, if not complete cessation. He was assured by Dr. Quam that somehow the ARL and its

programs would continue to be supported. For example, it became clear on discussion that NSF would indeed consider support of biological projects at ARL, but they would be considered in competition with all other biological project proposals and not be placed in a favored category because they were arctic.

Finally it was decided that The Johns Hopkins University would continue as the contractor for the administration of ARL. ONR also found ways of supporting some of the more meritorious projects in biology as well as in the physical sciences. Another change was to allocate ONR funds to the Arctic Institute of North America which, under appropriate ONR controls, was able to make subcontracts for research projects at the ARL.

On January 1, 1953 the various projects and activities of the ARL were described again by ONR for the use of the Research and Development Board of the Department of Defense. The general requirement for arctic research in the naval interest was stated as follows — "Investigations supported by this project will provide background information for Navy operations in Arctic and sub-Arctic regions. In view of the potential importance of the Arctic as an area of military operations, it is clearly advantageous to provide, as soon as possible, a good working knowledge of Arctic environments. Such information is of value to the Navy in planning Arctic operations, developing cold weather techniques,

and designing proper clothing, housing, engineering structures and materiel . . . Systematic knowledge in these fields is incomplete for all circumpolar regions and especially for the Alaskan Arctic".

In late 1952 and early 1953, with the prospect of the closeout of Pet 4 and the increasing emphasis in ONR on supporting projects of clearly naval interest, the continuing support of the relatively large biological program at ARL became more difficult. It was hoped that the NSF would move into this situation and pick up the support of a good many of the biological projects. On February 15, 1953 the SDARL wrote Dr. Quam in ONR—"Does the inclusion of this whole slate (biological project proposals) under the AINA aegis mean that NSF has refused to support a single one of the various proposals . . . if NSF turns thumbs down on all these projects my faith in that agency will suffer a severe jolt". Dr. Quam replied—"The National Science Foundation has informed us that they will support Dr. Steere only and I understand they are unable to meet the full amount of his request. I am unhappy about this because I do not like to see one of our best scientists supported at a lower rate than others. Perhaps we can arrange supplementary support through Johns Hopkins or the AINA." To this, Wiggins responded—"The National Science Foundation support is so small that it is mighty close to being none at all. I'm disappointed in view of the lack of enthusiasm we encountered among the people of that organization with whom we talked."

About mid-January, the SDARL was informed by ONR that a contract was being negotiated whereby the AINA would cover the cost of most of the research projects at the ARL except some to be supported directly by ONR and the projects of other federal agencies. It was felt that greater efficiency would be attained because in the past, ONR had been processing about twenty five separate contracts with individual universities, some in very small amounts. The AINA was chosen because it had a Research Committee of arctic experts to advise on an effective program. Because of its binational character, AINA also was in a position to coordinate arctic research in Canada and the United States. The new pattern got underway with relatively minor difficulty. The AINA was slow in effecting the first grants (subcontracts). Early in May the SDARL wrote Dr. Quam—"The question I would like to ask is, whether or not anything can be done from your end to hurry along the AINA office in New York?"

As far as ARL was concerned, 1953 was dominated by the closeout of Pet 4, the supporting organization. It really started early in March with a wire to ONR, Code 414 C, from the SDARL that is quoted in part—" . . . information relative to discontinuation of exploration in NPR-4 has been received . . . Details concerning work load between present date and proposed closeout date 1 October 1953 will be publicized when available. ROICC and SDARL request information concerning plans to continue ARL beyond closeout and on scope of such continuation . . . ONR action in

continuing or closing ARL affects degree and manner of closeout of supplies and equipment by ARCON. Can a program be carried out by ARL summer 1953 on revised scale? Request instructions . . ."

A few days later, on March 14, the SDARL wrote in more detail about some of the urgent matters that faced him immediately in the situation. The following extract illustrates the problem—"The possibility of operating the laboratory under a reduced type of support, and with either the laboratory or some other agency having to take over the operation of maintaining the camp poses some rough questions. First, the ARCON people don't know how much of their equipment they are to take back to the States in the closeout process. Some equipment will have to be left here to operate the camp if anyone stays. For example, if the airport is to be kept in shape for planes to land a snow removing scraper, a cat (tractor), a small crane, a tank truck, and a number of other items will have to be on hand. Hauling water from the lake to the buildings will require at least one cat and Athey wagon, the oil distribution will require another Athey wagon, but the one cat could handle the combined job. If the camp is to be large enough to warrant keeping the mess hall open, the steam plant will need to be kept in operation too, in order to keep the drain pipes thawed and to furnish heat for the laboratory and the mess hall. Laundry and dry cleaning equipment seem to be necessary if the personnel in camp is to run around 60 to 80 people, and that is the number that would

need to be here during the peak season if ARL has say 30 to 40 people at the lab and if there is a crew to keep the airport, laundry, power plant, steam plant, messhall, water and fuel distribution, machine and repair shop, and a warehouse and timekeeper on the job."

By shortly after mid-March, Dr. Quam felt that the research program could go on through the summer of 1953, but that ARL would have to close by October unless some other agency takes over the operation. As of about that time there was a feeling that the Air Force might take over the Pet 4 facility on a caretaker basis, in view of possible future need, but would not be able to support the ARL.

Also about the same time, the Chairman of the ARLAB prepared a detailed analysis of the situation and made a number of recommendations based on several alternative assumptions. On March 27 Code 414-C forwarded the analysis to Code 400 and concurred in the major recommendations. The transmitted memorandum reported as follows—"Accordingly, the following actions are being taken:

"a. The Director of the Arctic Research Laboratory has been requested to come to Washington on 7 April to plan a closeout of the present ARL operation during the present calendar year.

"b. A final meeting of the Arctic Research Laboratory Advisory Board to inform the members of the suspension of operations under present arrangements will be called.

"c. The Smithsonian Institution will be informed that the ARLAB contract will be terminated when it expires on 30 June 1953.

"d. The Johns Hopkins University will be informed that its contract for operation of the ARL will be terminated when it expires on 31 December 1953.

"e. Office and storage space at Fairbanks will be requested from the U. S. Geological Survey when this agency takes over the Navy facilities at Fairbanks.

"f. Steps will be taken to continue the Arctic Research contract with the Arctic Institute of North America, and to expand its scope to cover research tasks in all parts of Arctic and Sub-Arctic areas and to provide expert consultant services to Code 414.

"g. It is recommended that ONR arrange for representatives of interested military and civilian agencies to inspect the ARL facilities at Point Barrow and Umiat in late May 1953 to consider reactivation of the laboratory under joint sponsorship and if this is not feasible, to arrange the closing of the facility or placing it on a caretaker status."

By mid-October ONR announced that the ARL would continue on a reduced basis—anticipated personnel about 25. The program would be cut back especially in natural-history projects. Permafrost, radio propagation, earth's magnetic field, physics of sea ice, and underwater acoustics would be among studies to be emphasized. Before the end of October

the DNPR had asked ONR to assume the custodial function for the whole Barrow camp. ONR wished to do this as the funds for that service from ONPR would help cut the cost of operating the ARL and would leave a little more for research projects.

One of the recommendations of the Chairman of the ARLAB was that the ARL be inspected by a military and civilian group with a view to desirable future operations. This was recommended by the Head, Geography Branch, Dr. L. O. Quam, on April 7, 1953. He noted that the AINA was making a study of the status of arctic research and felt that representatives of AINA and selected military personnel experienced in arctic operations should review the ARL program. He also requested that AINA make available to the SDARL for use in a review of ARL accomplishments such material as it had accumulated on the status of arctic research.

On April 23 Code 414 officially proposed the formation of a group and a visit to the ARL. Five names were suggested as well as named representatives of ONR, Army, Air Force, RDB, Geological Survey, and AINA. CNR on May 7 requested a special air mission to leave Washington on June 29 and return on July 7. A few days later the CNR, RADM C. M. Bolster, requested Dr. Carmichael, Secretary of the Smithsonian Institution, to establish the group. On June 9 the OICC in Fairbanks was informed of the proposed visit to the ARL, and that it had been cleared with the DNPR, Captain R. H. Meade.

The group included—

Keith Boyd—SIPRE	LCOL G. P. Jones—USAF
Earl G. Droessler—RDB	COL A. E. Krieger, Jr. —USAF
J. Glen Dyer—Weather Bureau	John C. Reed—Geological Survey
John Field—UCLA	RADM E. H. Smith—WHOI
James E. Gillis, Jr. —SIPRE	LCOL A. I. Karstens—USAF
CAPT Ray Hansen—USAF	F. H. Quimby—ONR
LT Josephine Bates—ONR	Evelyn L. Pruitt—ONR
W. B. Girkin—ONR	George Sprugel—ONR
Norman A. Maier—ONR	

Dr. John Field acted as chairman. He reported to RADM Bolster on July 10 that the group had inspected the Geophysical Institute at the University of Alaska, the Field Office of the Army Corps of Engineers near Fairbanks, and the Arctic Aeromedical Laboratory at Ladd AFB. Conversations were held with the OICC in Fairbanks and with the DNPR. "The possibilities for joint operations with both military and civilian interests were explored. Finally, the advisability and importance of a laboratory at Point Barrow, such as the Arctic Research Laboratory, were appraised in some detail." The report stated—" . . . this group is of the unanimous opinion that the closure of the Arctic Research Laboratory would have a seriously detrimental effect upon the overall military research and development program in the Arctic." By letter to the CNR dated July 30, the OICC concurred fully in the recommendations contained in the report.

By mid-July Dr. Wiggins had made it very clear that he would not be continuing as SDARL if The Johns Hopkins University contract was not renewed at the end of 1953. Especially he would not be able to remain if the Arctic Institute of North America became the basic contractor. Apparently the only situation in which he would consider remaining would be for the operations contract to go to Stanford University, his home institution. By the end of July it appeared that Stanford University might be interested in taking over the ARL. At about the same time the Secretary of the Smithsonian Institution indicated his interest in the ARL to officials of ONR and "hoped that in some way the Smithsonian Institution would continue to be involved, either by running advisory committees or participating in some other fashion." The reader will remember that a year earlier both the University of Alaska and The Institute of Arctic and Alpine Ecology at the University of Colorado had expressed an interest.

In mid-October the Geography Branch of ONR requested the AINA to consider the formation of a group 1. to advise ONR on gaps in knowledge of the Arctic, 2. to evaluate proposals submitted to AINA in terms of scientific merit and appropriateness for ARL, 3. to stimulate and encourage scientists to conduct work at the ARL, 4. to conduct studies on programs or problems as requested by CNR. Toward the end of October it was generally known that Stanford University did not choose to become involved in any ARL operating contract. This seemed to be a

disappointment to Dr. Wiggins. On November 3, as one of his first acts as the new President of the University of Alaska, Dr. Ernest Patty clearly stated that that university would like to operate the ARL and that Dr. Elvey, the Director of the Geophysical Institute at the university, would shortly be in Washington to discuss the matter with ONR. Concurrently, the California Academy of Sciences indicated its possible interest in submitting an operational proposal. Some interest also had been expressed by individuals at the University of Southern California and Northwestern University.

Dr. Patty followed up with another letter to ONR on November 11 and suggested that Ted C. Mathews, who had been Assistant Project Manager for ARCON in the Pet 4 operation, might be interested in taking the position of Director of the ARL. Also in November the ONR began to negotiate with the ONPR toward the anticipated ONR contractor taking on, in addition to the usual ARL duties, the custodial responsibilities for the large amounts of supplies and equipment left at Barrow. ONR looked favorably on this idea, as payment for the custodial duties would significantly reduce the cost of operating the ARL.

Time, as usual, was pressing and there being, as of December, no new contractor, it was necessary to ask The Johns Hopkins University to carry on for a few months. Finally on December 29 the University of Alaska was given preliminary notice that it was being awarded the operational contract and that the Contract Division would negotiate the contract.

The Board Advises, Then Fades Away

The ARLAB assembled in Washington on August 7, 1950 in a special meeting to consider first the urgent matter of the designation of a new SDARL, and then a number of other matters that were becoming of real concern. This was just a few days before Dr. Wiggins actually began to direct the ARL. It took the Board only a few minutes to listen to Professor MacGinitie's letter of withdrawal and to recommend unanimously that Dr. Wiggins become the new SDARL.

Then attention was directed to the other problems that faced the ARL. Chief among these were—

1. The possibility, indeed the probability, that the Pet 4 operation would cease in the near future,
2. The effect of the Korean War on the ARL and its projects,
3. The policy of the ARL toward the support of military projects, and
4. The need to be able to provide a new SDARL without confusion whenever it is necessary for one to leave.

In regard to point 1, CAPT R. H. Meade, who at that time was Deputy Director of Naval Petroleum and Oil Shale Reserves, and who was acting for Commodore Greenman, DNPR, pointed out bluntly that "oil exploration activities may run out because of lack of resources or because of pressure of competing activities."

In fact, Pet 4 did not terminate as soon as CAPT Meade thought it might. However, it did close in the fall of 1953 during Dr. Wiggins'

tour as SDARL but only a few months before he left. Furthermore, the ARLAB met for the last time in mid-April 1953 and then quietly passed into history.

CAPT Meade also said, as it pertained to point 2, that if the ARL is devoted to basic research only, it might have to be given up entirely and that there was every reason to expect that as long as there is a project of applied research, there is a surer chance of the Laboratory continuing. The Korean war was occupying the attention of the nation, and support for an obscure laboratory in arctic Alaska and for research projects to go on under that laboratory was indeed hard to come by, and rapidly getting more so. CAPT Meade's advice was hard-headed, but practical. CAPT W. H. Leahy, Assistant Chief for Research, ONR, who also attended the meeting, remarked that he thought there would be some shift of emphasis from basic research to applied research, but that ONR intended to keep underway a fundamental research program also.

In reference to point 3, the ARLAB had been vaguely uneasy about the acceptance of projects of other military agencies for support without their being reviewed or approved by the Board. The desirability and inevitability were at least partially understood, but the Board, as well as the contractor, The Johns Hopkins University, were disturbed because large segments of research resulted in which the Board had no opportunity to exercise judgement and in which the University had a responsibility for support under the contract, but no control.

A pertinent illustration was before the Board. The Air Force wanted 400 square feet of space in the ARL for "studies in geophysics". The DNPR was in favor of making the space available, the SDARL said the space could be assigned. It was also pointed out that the Army might wish to initiate a project of ice study although no formal request had yet been made.

A subsidiary problem was whether or not the SDARL should be cleared through "Secret" in the security classification scale. Some of the proposed military projects might be classified, and the SDARL would have to know about them if he was to support them. The ARL projects themselves were all unclassified.

Point 4 was a recommendation that a subcommittee be designated to review possibilities for a new SDARL. At that time it was thought, erroneously it proved later, that Dr. Wiggins would be leaving in the fall of 1951.

Finally it was announced by Dr. Shelesnyak, who headed the Arctic Institute office at The Johns Hopkins University, that he would be leaving the Institute and North America to accept a research post in the Weizmann Institute in Israel. Thus departed from the scene a man who had had as much as anybody to do with the establishment of the ARL and the plotting of its first course in the accomplishment of research.

On November 14 the Board met again, this time in the Regents Room of the Smithsonian Institution, to carry further discussion of the points

raised in the special meeting in August. ONR reported that it had been making estimates of the cost of operating the ARL on its own and that it probably would be three times the current cost. Any other participants willing to carry their share, would of course reduce the cost to ONR. By that meeting Captain Meade had replaced Commodore Greenman as Director of Naval Petroleum and Oil Shale Reserves. He thought that ONR should take the initiative in identifying agencies that might be interested in activities in the Barrow area and hence in helping to keep the ARL going. He reported that the plan was to stop oil exploration by July 1, 1951, but that some activities would continue until the end of the year.

Dr. Bronk, the President of The Johns Hopkins University, and of the National Academy of Sciences, emphasized the interest of the Academy in the ARL as a center of civilian science.

Then followed a rambling discussion of authorities and responsibilities that revealed a good deal of confusion in the ARLAB and the need to do something about it. This was triggered by P. Stewart Macauley, the Provost of The Johns Hopkins University, who felt that the responsibility of the SDARL to ONR and to the University was not clearly defined. Dr. Field countered by pointing out some administrative principles in ONR, and that the SDARL had to be the representative of the CNR at the Laboratory and especially in dealing with the OICC of the oil exploration program. He pointed out that the SDARL is not responsible to the ARLAB and that the ARLAB advises the CNR and not the University.

Dr. Bronk felt that the ARLAB should consider the type of research that should go on at the ARL and find people interested in such research. At this point, the Board recommended that the SDARL spend a good deal of time recruiting researchers in the States and that he be supported by a deputy at the ARL while he was away on recruiting or other missions. The Board ducked the recruiting function and stated that it felt its prime responsibility was to advise on the type of program. The Board decided on a committee to "consider the relationship, responsibilities and authorities of the ARL, ARLAB, The Johns Hopkins University, and the Office of Naval Research". The committee was made up of Dr. Wiggins for the ARL, Dr. Reed for the ARLAB, Mr. Macauley for the University, and Dr. Field for ONR.

Dr. Wiggins also reported on the facilities at the ARL. He mentioned the shortage of transportation equipment and predicted that the situation would get worse. His recruiting efforts had resulted in 14 individuals indicating interest in projects at the ARL beginning in the summer of 1951.

The small subcommittee designated at the seventh meeting of the ARLAB in November 1951 wasted no time in getting to work. It met on November 28 and went through the whole discussion again. The result was expressed in four recommendations ---

1. A statement of the responsibility of the SDARL and of the contracting institution for the conduct and recruitment of a scientific research

program should be included in future contracts for the operation of the ARL. The SDARL is responsible to the contracting institution for the program and management of the ARL as defined in the contract. In all other matters he is responsible to the CNR.

2. A statement of the responsibility of the ARLAB to advise the contracting institution regarding program planning should be in future contracts for an advisory board.

3. An important function of the SDARL and of the members of the ARLAB is pointing out to qualified investigators the opportunities for research at the ARL.

4. The SDARL should have an assistant who would have full responsibility at the ARL in the absence of the SDARL.

Again the ARLAB met on January 29, 1951 in the ONR. It accepted and approved the recommendations of the subcommittee. It also approved 14 proposals for projects. These were the direct result of recruiting efforts by Dr. Wiggins.

The Board was informed that ONR hoped to make arrangements with Stanford University whereby Dr. Wiggins, who was the Director of Stanford's Natural History Museum, could remain as SDARL on a part-time basis. This move was endorsed.

Again, the changing situation was reviewed in regard to the continuation of the oil-exploration program (Pet 4). CAPT Meade stated that,

unless very favorable exploration results were obtained before July 1, 1951, exploration would cease as of December 31, 1951 and logistic support would be available only until June 30, 1952. CAPT Meade said he was going to call a meeting of potentially interested agencies to determine to what extent they might wish to help support a continuing facility at Barrow. The ARLAB strongly recommended that the ARL be continued regardless of the continuation of Pet 4.

The ninth meeting of the ARLAB was held on May 16, 1951 at Fort Churchill, Manitoba, Canada. This long-planned meeting, for which Graham W. Rowley of the Defence Research Board of Canada was largely responsible, gave the Board an opportunity to view the operations of the Defence Research Northern Laboratory and to make comparisons with the ARL. The Board was especially grateful for the opportunity to meet at Fort Churchill to Mr. Rowley; COL D. F. Forbes, RCA, Commandant; and Dr. K. C. Fisher, Director, DRNL. The formal invitation to the ARLAB was issued on April 5, 1950 by A. L. Wright, the Defense Research member of the Canadian Joint Staff in Washington.

Largely for the benefit of the Canadians present, but also as a means of summarizing the current situation, the Chairman outlined the arrangements between Arctic Contractors (ARCON), Naval Petroleum and Oil Shale Reserves (ONPR), the Office of Naval Research (ONR), the Bureau of Yards and Docks (BUDOCKS), and the ARL. Mr. John Knauss

of ONR reviewed the scientific program of ARL. He reported to that date 450 man months of research—60 percent in the biological and 40 percent in the earth sciences. The SDARL outlined the present program at the ARL including research, housekeeping, and administration. LCDR Paul H. Kratz, ONR summarized the cost of operation of the ARL. He pointed out that cooperation and assistance from BUDOCKS, ARCON, and ONPR had aided materially in keeping down costs of research and logistics.

It was announced that Dr. John Field, Executive Secretary of the ARLAB and Head, Biology Branch, ONR, would be leaving ONR in June. Dr. S. R. Galler would be Acting Head until a replacement was found for Dr. Field. COL O. F. Kotick, Deputy DNPR, reported for CAPT Meade that a meeting had been held on February 16, 1951 to assess the interest of agencies in continuing at Barrow. Some interest was shown, but not enough to assure continuation after Pet 4 at anything like the current scale. Three possibilities were discussed—

1. Continuation in the present manner after Pet 4 if sufficient support can be found,

2. Establishment of the ARL at Umiat, inland from Barrow at the southeastern edge of NPR 4. Umiat was the site of a substantial exploration camp and had an airstrip, buildings, and all needed facilities. All support would have to be by air.

3. Establishment of the ARL on the campus of the University of Alaska. It was decided that this alternative would be investigated by the Executive Committee.

After a discussion of the military significance of the ARL, the Board recommended an analytical study of the strategic and tactical significance of the Arctic "with a view to the formulation of an integrated research program for military purposes". The Board felt that a substantial part of such a program could go on at the ARL. It also felt that a group of scientists and military representatives should work full time for several months on the problem. This recommendation was made specifically to the Chief of Naval Research by the Chairman of ARLAB by letter dated June 8, 1951.

About four months later the ARLAB met in its 10th regular meeting in McKinley Park, Alaska, on September 6, 1951. The meeting was at McKinley Park because one of the Alaskan Science Conferences, sponsored by the Alaska Division of the American Association for the Advancement of Science, was being held there at that time. By that date and since the meeting at Fort Churchill, Dr. Field had left ONR and the responsibility for the ARL had been transferred to the Geography Branch of which Dr. L. O. Quam was the Head. Thus at McKinley Park, Dr. Quam appeared as the new Executive Secretary of the ARLAB. Dr. Quam explained ONR's concept of the relationship between the ARLAB and a new coordinating

committee that had been established at his request within ONR to assure coordination among the scientific branches of ONR. He felt that the ARLAB should be continued, but that its membership should be changed somewhat in order to provide advice on the scope and balance of the overall ARL program. The individual branches of ONR would pass on the scientific merit of proposals. The position of Dr. Quam was appreciated by the Board, and a motion was passed recommending that the existing Board be discharged as a first step in the constitution of a new Board.

The Board reiterated its position taken at the Fort Churchill meeting that it needed a knowledge of the significance and importance of the Arctic from a military standpoint. The Board stated "That the Board awaits with keen interest an answer to its request . . . for an analytical review of the strategic and tactical significance of the Arctic with a view to the formulation of an integrated . . . program for military purposes. The Board desires a statement of the degree to which this program would be prosecuted at the Arctic Research Laboratory . . ."

The threat of an early closing of Pet 4 had receded somewhat by the 10th meeting. The Chairman stated that there was no immediate danger of the closing of Pet 4, and that ARL could be supported at least through 1952 and perhaps longer. Meanwhile, the Chairman and the Executive Secretary were asked to keep abreast of the interests of other agencies in the Arctic.

The SDARL reported on the plant and equipment, especially transportation equipment. He felt that the 1951 research progress had been substantial and that the outlook for the season of 1952 was excellent. The Board approved a plan whereby Dr. Wiggins would continue as SDARL, but would spend about 6 months (October 1 - March 31) at Stanford University where he was a Professor of Botany and Director of the Dudley Herbarium. While at Stanford, a good deal of time would be spent in recruiting projects for the ARL.

The first meeting of the reconstituted ARLAB assembled in Washington on January 21, 1952. It was announced that the membership of the new Board was —

Dr. Alexander Wetmore, Smithsonian Institution,

Dr. John C. Reed, U. S. Geological Survey,

Mr. E. W. Johnson, Bureau of Yards and Docks,

Dr. Detlev W. Bronk, The Johns Hopkins University,

CAPT Robert H. Meade, Naval Petroleum Reserves,

Dr. Ira L. Wiggins, SDARL,

Dr. J. Frank Schairer, Carnegie Institution of Washington,

Dr. Kirk H. Stone, University of Wisconsin.

Dr. Reed again was elected chairman of the ARLAB. The group also recommended for membership Dr. J. L. Giddings of the University of Pennsylvania and Dr. Clifford A. Barnes of the University of Washington.

It was explained to the Board that the present situation in regard to the oil-exploration program (Pet 4) favored some expanded research opportunities in that Pet 4 would in the future expand outside Navy Petroleum Reserve No. 4 into adjacent areas.

The representatives of BUDOCKS explained the plan to suspend operations of its Arctic Test Station on July 1, 1952. He said that some work might go on there from time to time. The SDARL made a strong recommendation for an ARL building at Umiat.

Two projects receiving support from the ARL were described. They were Ski Jump II of the Geophysics Branch of ONR and the permafrost program of the Geological Survey. Eighteen ARL proposed projects were reviewed and approved. Three others were not approved. It was recognized that those of the projects approved could not be supported unless the proposed building at Umiat was obtained.

Not for ten months did the ARLAB meet again on November 24, 1952 for its 12th meeting. During that long interval a lot had gone on in ONR and at the ARL. A full season of research had been carried on, and much progress had been made. Again at the 12th meeting the future of Pet 4 was discussed. It was felt confidently that two or three more years of oil exploration were likely and that support as in the past could be supplied to the ARL.

The SDARL made a detailed report, which is summarized later. The report was excellent and included not only information on the physical

plant and the research program, but also a great deal of information on support of related activities and operating conditions and problems. Dr. Wiggins felt that the scientific data accumulated through ARL projects was of inestimable importance. A good deal of discussion was given to the potential interest of the NSF in the Arctic and in the possibility of NSF supporting some of the scientific work at the ARL.

About five more months passed, and the 13th meeting of ARLAB assembled in the Regents Room of the Smithsonian Institution on April 13, 1953. Seven Board members and alternates were present including two new members—Dr. A. L. Washburn and Dr. Leonard Carmichael, who had replaced Dr. Wetmore as Secretary of the Smithsonian Institution.

RADM C. M. Bolster, CNR, delivered the bombshell. He congratulated the Board and thanked the members for their work over the years. Then he said "It seems to me that the Board has carried out all these objectives and it has been a very fine thing to have a Board that is willing to devote its time to this problem. As you know, we had some difficulty in getting the Laboratory started at Point Barrow. In spite of this the work thrived and we feel it has been a very worthwhile endeavor. I regret that Pet 4 has discontinued its operations . . . There is not much point in continuing the Board since the Laboratory will have to fold up."

The Chairman outlined the incidents since the November 1952 meeting that had led to the decision to close the Pet 4 operation. The

Executive Secretary reported arrangements between ONR and the Arctic Institute whereby many of the proposed projects could be carried by AINA grants-in-aid with ONR support.

Thus closed the last meeting of ARLAB. Curiously, the ARL went on, so that Admiral Bolster's statement that "the Laboratory will have to fold up" was found later to be unduly pessimistic. Still the statement did effectively terminate the ARLAB.

In the official file of ARLAB minutes, in the space assigned to the 12th meeting, is an undated memorandum to ARLAB members from the Executive Secretary. That memorandum constitutes the report of a sub-committee designated at the 12th meeting to report on the continuation of the ARL after the close of the oil-exploration program. The report must have been prepared before the 13th meeting, because obviously it was prepared at a time when the oil-exploration program was expected to continue. Still, no mention seems to have been made of the report at the 13th meeting, and it is completely at variance with the statement of the CNR that "the Laboratory will have to fold up".

The report contains eight numbered items. The following quotations are from those items —

"1 . . . the committee feels that Pet 4 is likely to continue for at least three more years.

"2 . . . every effort should be made to continue the research work at the laboratory when and if the oil-exploration program ceases.

"3 . . . a definite and specific plan should be prepared now and revised as may be appropriate so that it can be put into effect without delay as soon as definite information is available on the closing of the oil-exploration program .

" . . . many other units of the military and civilian departments have a real interest in a going facility in northern Alaska . . .

"7 . . . a budget should be prepared based on estimates worked out with Arctic Contractors for the continuation of the air fields, power house, gas well, a minimum of air navigation aides, housing, laundry, messing and billeting, etc. so that some idea will be at hand relative to the cost . . . this estimate can best be obtained by the SDARL.

"8. The committee is cognizant of the recent designation of a Technical Assistant for Polar Projects in the Office of the Chief of Naval Operations for coordinating arctic research activities within the military services. The committee suggests that the office, with the estimate mentioned in item 7, contact all other interested units in an attempt to work out an appropriate share-the-cost basis for indefinite continuation."

The ARL in a Changing Local Environment

The usual problems of local administration confronted Dr. Wiggins as soon as he took over the ARL reins. Toward the end of October, the Chairman of the ARLAB was assigned to naval training duty as a reserve

officer to the petroleum exploration program. He spent a good deal of time at the Navy camp at Barrow and took the opportunity of discussing various problems of the ARL with the new SDARL. One such matter considered was the fact that the ARL appeared to be little known in the scientific community even after several years of operation. Both felt that more widespread word of the ARL was needed and they recommended---

1. Occasional articles about the ARL in Science and in other journals,
2. Acknowledgement of the ARL in scientific papers resulting from work there,
3. A popular article from time to time in non-scientific journals,
4. Talks at universities by the SDARL and others,
5. Dissemination of ARL information by the members of the ARLAB,
6. Collection and use of movie films and slides of the ARL, and
7. Participation by ARL researchers in scientific meetings.

During the summer and fall of 1950 military air transportation between the States and Alaska had been becoming scarcer and much less reliable. As the season was closing in the North, about eleven researchers had real difficulty because no provision had been made for sending them back by commercial air. This situation took a large amount of time and effort to solve. A half dozen or more scientists anxious to get back to their families and their classes were not eager to wait for days for unreliable military air. Their individual contracts generally contained

neither the money nor the authority for commercial air. The OICC of the oil-exploration program in Fairbanks was not in a position to authorize commercial air, neither was the SDARL, nor Johns Hopkins under its contract except for Johns Hopkins researchers. So it went—but they all got back at last.

Local air transportation also became a sporadic problem, and this is standard for such an operation. Wiggins wrote to the point at the end of October—"You may be interested to know that we are again having flying trouble. The line haul plane took off from Fairbanks last Saturday morning, but had some kind of mechanical trouble at Umiat and could not continue. That cancelled the line haul for Saturday, because their other C-46 was already grounded here at Barrow awaiting a part that was on the C-46 disabled at Umiat. So they flew a mechanic from here to Umiat with tools to work on the plane there, but the Norseman that took him down there was not able to get back here yesterday owing to restricted visibility at Umiat. So today, Monday, I'm still waiting and hoping for a break that will let me get to Fairbanks today or tomorrow. So far, there is no information available here about even an ETD of the plane at Umiat, and so far, the Norseman has not come in with the new part for the grounded C-46 here! Oh, it's a grand situation, I can tell you."

A minor flurry arose also around the matter of shipments made to the ARL from locations in the States and from the ARL to the outside.

Before the summer of 1950 the bills of lading had been charged to a BUDOCKS item set up to cover shipment of all Navy property in and out of NPR4. Then it was decided to charge each bill of lading back to the source, in this case, the ARL. No account for such charging had been established by ONR with BUDOCKS, and so there was no place to enter charges. The problem, in retrospect, seems simple enough, but it cost no end of time, money and patience to straighten out. Partly this was because the situation became acute near the close of the field season when the researchers wanted to send out their own gear, specimens and instruments.

Financial matters always are a continuing concern to a government administrator, and the SDARL was no exception. Nevertheless, he seems to have kept the problems to a minimum, with the cooperation of the OICC in Fairbanks and the willing help of Mrs. Reamy and BUDOCKS in Washington. A few examples will indicate the kind of things that arose in Dr. Wiggins' first few months. A memorandum from the OICC dated September 8 showed the total cost of air support for the ARL to have been \$24,446 in 1948, \$20,296 in 1949, and \$6,773 in 1950 from January through August.

Mrs. Reamy wrote the SDARL on various matters on October 12, and in regard to financing, the memorandum contained—"We will need an estimate from you on the amount of money needed for this period (January 1 to June 30, 1951). MacGinitie's estimates were for the fiscal year

July 1, 1950 to June 30, 1951. The reason for this new dividend estimate is that ARCON operates on calendar years and the Navy on fiscal years, and the only way to accurately determine what is what by fiscal years is to divide the calendar year into two halves".

On October 18 the SDARL submitted the estimates requested for the interval January 1 through June 30, 1951 —

Messing and billeting	\$13,240
Freight and express	6,200
Airlift	4,280
Physical plant and equipment	
Building and maintenance	4,000
Equipment use	2,250
Materials and supplies	2,400
Contingency	1,730
	<hr/>
	\$34,100

He went on to point out that the shipping estimate was higher than previously because of the new rules about bills of lading. Also building maintenance was high, because the older main laboratory building (No. 250) had had to be jacked up and releveled because of the melting of permafrost beneath it.

As usual, small administrative flurries swirled occasionally around a few of the people involved. These arose because of

misunderstandings, personality clashes, or because someone was trying to take a short cut or gain an advantage that could not be allowed by the SDARL. Robert F. Black, who directed one of the permafrost projects of the Geological Survey, became such a storm center briefly. He felt that his project was due special aircraft support, because a figure for that support had been in his original budget. Somehow the figure was not finally included, and its original inclusion, of course, was not known to the SDARL. A heart to heart talk, initiated by the SDARL, seemed to cure the problem or at least alleviate it.

On September 13 the Administrative Assistant, ARLAB, sent a short note to Dr. Wiggins that marked a milestone in ARL history. It pointed out that two new men were on their way to replace the MacCarthys in one of the Geological Survey permafrost projects. One of these was Max C. Brewer, who later became the outstanding and long-time Director of the ARL from 1956 to the present. That young man immediately made an impression. He arrived at the Laboratory on September 16, and only four days later Dr. Wiggins wrote ---"He has taken hold of the geophysical work here with a will and has already learned the location of several of his test holes. He is a very enthusiastic young chap and will probably fit into the activities here quite well. He is still a bit green, but appears to be willing to learn and he certainly is an energetic worker. I think he will work out satisfactorily." Thus appeared on the scene a man who, in

retrospect, was destined to become one of the most colorful and influential characters of the American Arctic—to be ranked with only a few others, perhaps, such as trader Charles Brower.

Early in January of 1951, Dr. Wiggins contacted the President of Stanford University and proposed that his own project at the ARL, that he was carrying on in addition to his responsibilities as SDARL, be proposed for continuation through The Johns Hopkins University. This seemed acceptable all the way around. Also in the early part of 1951 there was some discussion and correspondence between Dr. Field in ONR and Johns Hopkins authorities about details of wording and implication that would be considered in connection with the extension of the Johns Hopkins contract when it came up for renewal at the end of June. Eventually some modifications in the old contract were made, and the renewal continued the contractual arrangement to June 30, 1952.

As a part of his general effort to make known in university circles the ARL and the opportunities there, the SDARL gave a lecture at Lehigh University on January 31, 1951 on "Research Facilities at the Arctic Research Laboratory at Point Barrow, Alaska."

Approval for women to go to the Navy establishment at Barrow and to participate in any of the activities there long had been a problem. Over the years since Pet 4 started, rules had gradually been worked out, and these applied to the ARL as they did to other activities. Generally approval

could be given only if the woman was married to a man working in the area and only if she also had a bona fide position in one of the activities. In 1951 two attempts were made to bend or evade the rules, and while a good deal of sympathetic understanding of the two cases was widespread, the rules proved stronger and the ladies did not go.

One of the cases was that of a female university professor who wished to carry on a biological project. She was denied entry in early 1951 after a substantial amount of forthright correspondence. In mid-April, after the case was closed, the SDARL commented in a letter "just between you and me, my patience is just about at an end so far as her efforts to crash the gate are concerned".

The other case was that of a woman who wished to visit the ARL to gather material for a book she was writing. After an original denial because the woman would have to be accompanied by her husband, she implied that she might take her husband along. Then she was told that the limited numbers of quarters for married persons were fully occupied. The SDARL was cautious because he felt that some appropriate publicity through her proposed writings might be good public relations. Eventually, the Office of Naval Petroleum Reserves said "No".

The first SDARL, Dr. Laurence Irving, in December 1950 requested permission to return briefly to the ARL in February 1951 to make certain skin-temperature measurements on mammals. He wanted

messaging, billeting, and some other support from the ARL. Dr. Wiggins approved this, subject to approval by the ONR and to the ARL being reimbursed for the cost of any support.

By January 1951 the efforts of Dr. Wiggins and others in encouraging submittal of proposals were having a real effect. It was becoming clear that 1951 would be a busy year with more projects than previously. In anticipation of the rush, the SDARL on January 23 started a request to have the ceiling of 31 allowed by the DNPR of investigators and staff members raised to 47. This was justified because of the additional space available in Building 251 and because there were available three apartment quonsets that would house six couples. His request shortly was approved, and the new ceiling was operative.

Another problem in the offing for the summer of 1951 was that of providing the required bush flying to the various projects. The ARCON flying was being provided to BUDOCKS through a contract with Trans-ocean Airlines. It was apparent that enough bush flying could not be supplied to ARL under that contract unless arrangements were made for another bush aircraft just for the use of ARL. The cost would be high because of the high cost of standby time. The SDARL requested and received permission to make a contract with Wien Alaska Airlines on a much better basis—a guaranteed minimum, but no charge for standby. It was determined that payment could best be made through the maintenance contract between ONR and The Johns Hopkins University.

By the end of 1951 and even with the new and higher ceiling of 47, it was clear that there might be insufficient accommodations for the summer of 1952. Accordingly, in a letter dated December 24 to Dr. Quam the SDARL proposed the construction of a quonset hut at Umiat to handle those projects that could be based there. That turned out to be a forward looking proposal that was most useful.

Another significant point in the record of the ARL was a letter dated December 24, 1951 from the SDARL to Dr. M. E. Britton of the Department of Biological Sciences at Northwestern University, who was applying for support of a project at the ARL in the summer of 1952. Thus comes into the record another scientist who became a part of ARL history for a long time and who was destined to head the program in ONR before many years went by.

In a memorandum dated February 14, 1951, the OICC of the Pet 4 program reported to the SDARL that his records showed the cost of ARL support for operations in 1947, 1948 and 1949, including overhead as —

	\$310,056
1950 operations totalled, including overhead—	70,864
	<hr/>
Total—	\$380,920

Through September 1951 the cost of operations for that year was reported by the OICC, Fairbanks, as \$37,905. Of that, a little more than \$21,000

was for messing and billeting. Air support for 1951 through September was billed at \$17,047.

An investigation of the Arctic Ocean through the use of aircraft working out of Barrow was initiated in 1951. The project, largely classified, was called Ski Jump and was supported by other units of ONR. The facilities of ARL were used substantially, but the arrangements were not well organized in advance and points of friction developed. As early as January 12, 1951 the SDARL was writing to Dr. Field urging that plans be made and approved for the purchase of gasoline for the Ski Jump aircraft and for the use of the Barrow airstrip.

The feeling of frustration was epitomized in a memorandum dated February 24 from the SDARL to Mrs. Reamy—

"3. A letter from John Knauss says that SKIJUMP as of now has a total personnel of 2 scientists, 3 officers, 3 CPO's and 2 enlisted men of lower grade. That makes ten. He then goes on to say that later on one or two more may come up to make a two-week camp on an ice island and may want to use SKIJUMP transportation from Pt. Barrow to the ice island, but that if the Air Force goes through with its plans for the arctic geophysical work, it might be more convenient and efficient for the geologist and glaciologist to get out to the ice island by utilizing the Air Force planes than to try to use the SKIJUMP transportation.

"4. In the meantime, we have heard nothing about SKIJUMP which, according to all dope we had heard earlier (again from Knauss) was supposed

to leave Washington on February 15th. Where is SKIJUMP now? If you can answer that question I'll soon begin to believe you have a crystal ball that should be duplicated and shipped to Point Barrow!"

Eventually the job was done—the project was successfully carried out. Then by mid-September 1951, the SDARL had begun to hear rumors of a Ski Jump II, to be carried out in the winter and early spring of 1952. He urged that if there was to be such an operation, and if ARL was to be asked for any support, the ONR Coordinating Committee and the ARLAB "should both have a chance to review the plan in its general aspects, even if the minutiae are being kept secret".

By early October some more specific information had reached the SDARL, but he was well aware that coordination was far from complete. He raised then such questions as—

1. How many men would be involved?
2. How many would be quartered at Barrow?
3. How would messing and billeting charges be handled?
4. Would ARL logistic funds required to support the operation be reimbursed?
5. Would cost of gasoline and aircraft maintenance be charged to ARL and be reimbursed or would BUAIR pay directly?

He clearly stated that he and the ARL would not be pushed around again as they had been in 1951. "When vehicles are assigned to a group,

that group is supposed to cooperate and not take unto itself the prerogatives of appropriating additional vehicles or other gear without first clearing with the Laboratory staff. Skijump personnel did that very thing on so many occasions in 1951 that in desperation locks were put on vehicles not assigned to Skijump. Cooperation should and will work in 1952 or there will be a strong protest lodged immediately with the proper offices in Washington. The protest was not lodged last winter because I felt that the whole project was poorly planned from the beginning and that the men who came to Barrow had not been fully briefed about the situation there. After last winter's work, however, the officer and the scientist presumably to be in charge have been to Barrow before and do know the setup. There is no room for any plea of incomplete information."

There followed a long exchange of information and opinions back and forth between the SDARL; his assistant at Barrow, Harry Balvin; and ONR. By mid-November most of the details seemed to have been resolved, but it is clear that the SDARL was still far from enthusiastic about being involved in Ski Jump II, starting about February 1952.

A similar, but smaller and less involved, incident than Ski Jump had to do with the establishment in the summer of 1951 of two electronic position indicators (EPI) on the shore of northern Alaska in connection with an oceanographic expedition of the icebreaker USS Burton Island in the Beaufort Sea. One indicator was to be at Barter Island, where the

facilities were operated by the Air Force, and the other at Barrow. The SDARL was asked to cooperate in several ways such as helping to arrange for the erection of the required masts by ARCON, allowing charges to be made to the ARL accounts for later reimbursement, and providing some logistic support.

The situation was summed up in a memorandum of the SDARL dated July 23, 1951. "The Burton Island pulled in here at Barrow sometime late last night. Some of its officers came ashore today and flew to Barter Island in the 'Doug', and I went along. My presence was supposed to be required because ARL had been the agency to which the cost of installing the tower here at Barrow was charged and because I had some information on the type of foundation needed, etc. Actually, I seemed to have gone along for the ride. Only civilian aboard the aircraft and the conversation was carried on almost solely between the Navy brass and the Air Force Captain who is CO at Barter. But they appeared to have reached some sort of agreement about the installation of the tower, the messing and billeting of the few men who would have to be there when the stations were being used by the people aboard the Burton Island . . . The foundation and the dead men for the guy wires to the tower are in here at Barrow. The Navy officers seemed a bit disgusted because we had not run precision survey lines to the site where we put down the tower foundation, but nothing was in the instructions issued to Cdr. Ricketts

nor to me about surveying. So I think they can run their own survey lines or ask the contractors to do so for them.

"Charging the air transport of the whole damned bunch of Burton Island group of scientists to the AML account . . . is a sizable amount; but far be it from me to kick if there is money in the kitty to cover it".

At the end of June 1951 the AML reported a summary of space available to ONR. It gave a good picture of the state of the facility, but omitted the 3 quonset family-living quarters that included 2 apartments each. The summary showed—

Building 250—1st floor

Laboratories (10)	2785 square feet
Darkrooms (14)	196 " "

Building 250—2nd floor

Offices	702 " "
Stockroom	735 " "
Library	1374 " "

Building 251—1st floor

Laboratories (7)	2493 " "
Garage	775 " "

Building 251—2nd floor

BOQ (Latrine and 12 rooms)	2325 " "
Lounge	655 " "

Building 251 —2nd floor (cont'd)

Shop	960 square feet
Shop storeroom	720 " "
Animal house	910 " "

On January 8, 1952 the SDARL left Barrow to return to his other duties at Stanford University where he expected to remain until the end of Stanford's winter quarter. He planned to return to the ARL and to bring Mrs. Wiggins with him. Just a few days before, his assistant, Harry Balvin, and Mrs. Balvin had left for Baltimore. Mr. Balvin was relieved as Administrative Assistant by Robert C. Johnson, and there was a rather short interval in which Johnson was indoctrinated by Balvin and by the SDARL. Dr. and Mrs. Wiggins returned on March 26. The SDARL also had to leave the ARL again on August 18 for business at the ONR, the NSF, The Johns Hopkins University, and Stanford University. After a busy time he was able to return again on August 26. Administrative Assistant Johnson completed his tour and left the ARL on December 15.

All Barrow personnel—Navy, ARCON, and ARL—were saddened by word on January 2 of the loss of one of the support planes, a C-46, on the Barrow-Fairbanks run. Four men were lost when the aircraft struck near the top of Chena Dome, only about 35 miles from the field at Fairbanks.

In 1952, as in all other years, many visitors came to Barrow on inspection trips or for other reasons. Most such persons called at least once at the ARL. They were always welcome, but in total, they occupied a substantial amount of the time of the SDARL and other ARL people. One such, that was a little unusual, was a visit in July by the Italian Consul General to the U. S. Northwest, Filippo Musti Falconi. A considerable flurry went on in the camp in an attempt, successful it turned out, to construct an Italian flag with which to welcome his arrival.

The proposal of Dr. Wiggins that an ARL quonset hut be built at Umiat for support of parties working in the field was accepted. The new hut was completed by mid-June and became "the little ARL". George E. Lindsey was detailed to Umiat, and he supervised much of the final preparation of the building, in fact, did a good deal of it himself—wiring, shelves, benches, and painting. The building was constructed for about one quarter of the estimated cost of \$6,000.

Twelve beds were installed, office equipment, and other furnishings. Also a weasel was assigned to "the little ARL". By the end of August, Lindsey had closed the Umiat facility for the season. In August there had been as many as 23 investigators living in field camps at one time—many of them supported from Umiat.

The extent of the operation is indicated in the table—

Bush flying out of Umiat in 1952

Leader	Institution	No. of flights	Flying time	
			Hours	Minutes
Bea	University of Kansas	11	24	30
Bellinger	Yale University	5	7	0
Cade	University of Alaska	7	12	45
Collins	National Park Service	6	14	30
Irving	University of Alaska	5	10	45
Leopold	Conservation Foundation	7	15	15
Livingston	Yale University	8	17	20
Steere	Stanford University	9	20	45
Willmovsky	Stanford University	2	1	20
Pitlik	University of California	1	2	15
Wiggins	The Johns Hopkins University	2	3	55
Totals		63	130 hrs.	20 min.

No accidents occurred during the bush flying.

For a time in the early part of 1952 the staff efforts were divided about equally between helping personnel of Ski Jump II and other investigations and in ordering supplies, unpacking gear, and repairing equipment in preparation for the coming summer season. As the days lengthened toward June and seasonal researchers appeared, more and more time was spent in serving investigators directly both in the field and at the Laboratory. The usual painting, reconditioning, and modification of the laboratories, shop,

and some other buildings went on during the late winter. Wanigans for project use as needed were constructed and hauled to the sites of field activities.

As time went on, the weasels became older, and replacements were almost impossible to obtain. In 1952 the ARL had six weasels at the ARL and one at Umiat. Their most effective use among the investigators required continual attention.

All field work in 1952 was directed from the ARL, because all supplies had to be assembled and distributed from there. A camp was maintained south of Barrow on the tundra from early May until October 6. About a dozen field projects were supported directly from the ARL, generally using a Cessna 170 of Wien Alaska Airlines stationed at Barrow.

General cleanup work, painting of laboratories, and repairs to equipment and the physical plant went on through December. ARCON began the task of jacking up and leveling the central part of Building 251, which had sagged badly as the permafrost melted under the structure. The work involved the excavation of a trench in the sand beneath the building, the placing of underpinning beneath the partitions, and the installation under the floor of ducts leading to the outside of the building. Cold air was forced by fan through the ducts, thus refreezing the material under the building.

In addition to the twenty-three regular projects operated in the summer of 1952, the following includes some of the other activities that were assisted—

1. In late May and early June logistic support was given to COL E. K. Day and MAJ Robert Rauch of the U. S. Public Health Service.
2. Some logistic support was supplied to Dr. Karl Reinhard in August. Dr. Reinhard was studying canine distemper.
3. Limited logistic support was furnished Dr. J. L. Giddings, Jr., of the University of Pennsylvania while he was studying dendrochronology of driftwood along the arctic coast.
4. In mid-January messing, billeting, and weasel time were supplied Marshall Johnson of Cornell University and the Aeromedical Laboratory at Ladd Air Force Base. He was studying lemmings.
5. Messing, billeting, and transportation to and from Fairbanks were furnished to eight scientists from the icebreaker, USS Burton Island.
6. Office space and living quarters were assigned to the observer of the magnetic observatory of the U. S. Coast and Geodetic Survey.
7. In August, messing, billeting, and bush-plane transportation to a point 45 miles from Barrow were furnished to two representatives of the Air Force Cambridge Research Center.
8. Living quarters were supplied to U. S. Coast and Geodetic Survey men in July and August.
9. An ONR investigator, Robert W. Rex, had worked on beach processes in the summer of 1952. He returned for a few days in October and was supplied with messing, billeting, assistance of an Eskimo workman, and transportation back to Fairbanks.

10. Occasionally during the summer, space was occupied in the ARL Umiat building by men of the Geological Survey, Arctic Contractors, Navy, and other agencies.

11. In September two scientists from the Naval Ordnance Laboratory received full support. Their cost was carried by ONR.

12. Two additional Air Force projects were supported, starting in mid-October 1952.

13. A man-and-wife team, Dr. and Mrs. Robert Spencer of the University of Minnesota, made arrangements to live during the summer in Barrow village and to make anthropological studies of the Eskimos there. They were supplied with food, laundry, etc. by the ARL.

The launch Ivik was sheathed with Douglas fir to reduce abrasion by beach gravel, a new outboard motor was loaded inboard with a skiff as a means of evacuation in case of accident. A depth recorder was installed that would reach to 100 fathoms and operate when the engine ran at slow speeds. She was launched on July 25 and was used extensively for offshore operations until she was hauled up on the beach on September 12. Fourteen separate cruises were made, but none were overnight. Ship-to-shore radio contact was maintained, but there were no emergencies. Several skiffs also were used near the ARL and in some of the lagoons at greater distances. Early in October the bow of the Ivik was covered with canvas and battened to withstand the winter storms. The small boats were stored for the winter.

For a long time Mr. and Mrs. Howard Hamilton, whose son, Roger B. Hamilton, had been lost in an aircraft accident in the Alaskan Arctic, had been trying to arrange to get to Barrow to view the area and to talk to people who had known their son there. Although the visit was believed inadvisable both by the SDARL and by Dr. Quam in Washington, it was finally arranged. They visited the Navy camp and the ARL in mid-July as guests of the Office of Naval Petroleum and Oil Shale Reserves.

Barex, the annual ship resupply expedition to Point Barrow, slipped in to anchor early in the morning of August 3. Unloading began before breakfast, and tons of supplies were soon piled on the beach and being hustled to the various warehouses. On August 5 the ARL was host to officers and seamen from the expedition which had brought a year's supply of food, lumber, paint, fuel, and a thousand other items.

The ARL held seminars every Friday evening from June 20 through September 15. Investigators were encouraged to participate. Attendance, open to camp and laboratory persons alike, ranged from about thirty to nearly seventy.

In 1952 the Third Alaskan Science Conference was held at McKinley Park in September. It was attended by 12 persons from the ARL, and papers were presented by seven of them. Also in 1952 the SDARL began to compile a list of publications resulting from work at the ARL. He knew the list was incomplete but, nevertheless, felt it to be impressive. The SDARL also conducted a symposium at the meeting of the Western Society

of Naturalists in Portland, Oregon on December 28. The SDARL was chairman, and several others from the ARL participated and presented papers in limnology, ecology, population dynamics, bryophytes, birds and insects, and the arctic ground squirrel. Participants included G. W. Comita, John L. Mohr, Donald E. Wohlschlag, William E. Steere, Frank Pitelka, William V. Mayer, and the SDARL.

Late in November, after he had attended a meeting of the ARLAB, the SDARL wrote Dr. Quam, the Head of the Geography Branch of ONR, of his discouragement at the way support for the ARL appeared to be deteriorating in Washington. He felt that ONR was about to drop support of biological projects on the thought that they should be supported by the NSF. He had no confidence that NSF would pick up the ball. Dr. Quam replied promptly and assured the SDARL that there was no intention of not finding support for worthy projects somehow.

As 1952 started and it was known that Ski Jump II would be coming along soon, the problems anticipated by the SDARL began to develop in spite of all his warnings of what to expect and how to forestall difficulties. On January 7 the Administrative Assistant at the ARL was informed that 50 pigeons would be sent to the ARL, as a part of Ski Jump. A pigeon loft had to be built, arrangements made for trans-shipping the birds in Fairbanks, instructions requested, and food procured. On January 23 the birds arrived. The attempts to use the birds for homing purposes were

not successful. After Ski Jump departed, the birds were kept for a while, but gradually they succumbed to the rigors of the arctic and became only a memory of frustration and wasted time.

As Ski Jump II got underway other more serious complications developed, as had been anticipated. The requirement for gasoline and how to pay for it, the expected problem of storage batteries which Ski Jump neglected to bring along in spite of repeated urgent recommendations, the arrangement for and use of weasels and payment for weasel time, the amount of publicity that attended Ski Jump, and many other rankling problems arose and eventually were solved.

Ski Jump II was a large operation—it consisted of 34 members—civilians, officers, and enlisted men, and of course required a great deal of support. On March 27 and 710 miles north of Barrow on the Arctic Ocean, in attempting to take off for a new oceanographic station on the pack ice, the left landing gear of the R4D collapsed. The propeller of the left engine sheared off, and the left wing was damaged. The crew was unhurt, but it was apparent that the extent of the damage and the distance from Barrow precluded the repair of the aircraft. The crew was picked up by a Navy Neptune under the command of CDR Coley on March 29. Thus ended Ski Jump II.

The list of persons at the ARL in June 1952 contained 49 names, not counting eight Eskimo assistants—truly an indication of the growth of the

Laboratory. The people represented 13 universities and colleges—

University of Kansas

University of California

Yale University

University of Pennsylvania

Pomona College

University of Missouri

Northwestern University

Michigan State University

The Johns Hopkins University

University of Southern California

University of Alaska

University of Minnesota

Stanford University

Also represented were four government agencies—the Geological Survey, the Arctic Health Research Center, the Office of Naval Research, and the National Park Service.

Early in June, Dr. L. O. Quam, Head, Geography Branch of the Office of Naval Research, arrived for several days of discussion with the SDARL and others. Thirteen investigators from the ARL attended the

Third Alaskan Science Conference sponsored by the American Association for the Advancement of Science held at McKinley Park. Seven investigators presented papers at the Conference that began on September 22 and continued through September 27. Also present at the conference was Simon Paneak, Eskimo hunter and trapper from Anaktuvuk Pass. His presence there was arranged by Dr. Laurence Irving, former SDARL. Dr. Wiggins said afterwards—"Taking Simon Paneak did more than a tremendous amount of talking could have done to show many of the people at the

Conference the personal dignity and independence of thought that is characteristic of the Northern Alaska Eskimo. He was easily an outstanding exemplification of the best that is found in these people."

November 4 was election day, and Barrow and the ARL eagerly awaited the special program that began at 4:00 A. M. , Barrow time. Mr. and Mrs. Arthur Lachenbruch, a permafrost-study team, held an election party in their quarters. The record says—"Some celebrated, a few wept. Stevenson's speech conceding to Ike came about nine o'clock."

On November 22 a military aircraft crashed during a flight from Seattle to Anchorage. All 52 passengers were lost, including CDR A. J. Seeboth, OICC for Pet 4.

As early as mid-January 1952 the SDARL was pointing out the necessity, unless the research program was restricted, of increasing the allowed ceiling of ARL personnel at Barrow from 47 to 57. On February 4 a formal request for that increase in ceiling was sent by the Chief of Naval Research to the Director, Naval Petroleum and Oil Shale Reserves. The OICC at Fairbanks, CDR M. H. Aubey, was reluctant to approve the increase without further justification and suggested a conference. In a letter dated February 15, the SDARL told the OICC that any delay in approval would seriously limit the planned research program. Finally on February 27 approval was given, contingent on the proposed ARL building being constructed at Umiat.

During 1952 as in other years, the ARL was called upon to support many projects not strictly ARL projects in one way or another—sometimes only slightly and sometimes to a very substantial extent. Two of these cases are interesting and are summarized.

At about the end of 1951 the SDARL received a letter from an investigator who was working on a problem under the Arctic Aeromedical Laboratory at Ladd Air Force Base in Fairbanks. He wanted to carry out certain biological studies in the area of activity of the ARL. The SDARL wrote to Dr. Quam saying that the man "apparently has a few erroneous ideas about the set-up at Barrow and Umiat . . . This project is one that has promise, and if the people at Ladd would like to have it carried along, and if we can extend to him the facilities of the Lab and the necessary transportation for a series of trips to Barrow and Umiat, I'm in favor of helping him as much as we can. The important aspect of the situation is his assumption that all he needs to do is say he wants to go certain places and make such and such observations, and automatically we extend to him the facilities of the laboratory, provide messing and billeting, and transportation. I hope that my letter makes clear that we operate through the courtesy of the Navy and the Arctic Contractors and that we abide by the conditions that prevail, even if it sometimes means reducing the full effectiveness of a particular project."

A case that arose in June had some unusual aspects, especially as it involved a member of the ARLAB. On June 25 Dr. J. L. Giddings, Jr.

of the University of Pennsylvania and his assistant stepped from an airplane at Barrow "without a soul in the Barrow base knowing that either was in Alaska". His project was not supported by ONR, but upon inquiry it turned out that ONR had wired the 17th Naval District, the SDARL, and the OICC that Giddings and his assistant were designated Naval Technicians and might be coming later. Apparently on the basis of an oral comment of an ONR representative in Philadelphia that the ARL could accommodate them and with their naval orders, they drove to Fairbanks, had their orders endorsed by an officer there, and boarded the aircraft for Barrow. A serious complication was that their presence after July 1 would put the ARL over its ceiling allowance of 57 persons. Dr. Giddings, according to a letter to Dr. Quam about this incident, "made no attempt to communicate with ARL. He thought it unnecessary. He had never seen a copy of the ARL Handbook, in spite of the fact that he is one of the new members of the advisory board . . . His intentions were completely honest and he had no idea that there had been any breach of the usual walls of procedure".

The situation was aggravated because Dr. Giddings desired to sail a 17-foot collapsible boat all the way along the north coast from Barrow to and beyond the Firth River in Canada, a venture thought to be dangerous and unjustified both by the ROICC at Barrow and by the CO of the Coast and Geodetic Survey at Barrow. Because Giddings had not applied to ONR for support, he felt that the local people were unnecessarily concerned about

his safety. As the SDARL rather plaintively said in his letter to Dr. Quam—"this is another one of the side door entrances to ARL that we have, theoretically, been trying to avoid. . . "

One of the most extensive, more or less extracurricular, tasks undertaken by ARL in 1952 was the partial support of Project Lincoln, a highly classified project undertaken by the Massachusetts Institute of Technology. Starting in November, several men were to spend about two months in the old facility at Skull Cliff that had been put in by ARCON, but later abandoned. On October 24 the SDARL wrote Dr. Quam that—"we have had some difficulties about arranging for the Lincoln project here at Point Barrow, and it is my impression that Dr. Schecter has been working under somewhat of a misapprehension about the whole situation with regard to logistic support and the care with which supplies can be gotten to Skull Cliff. Mr. Goossen (an advance representative of Project Lincoln) and I visited Skull Cliff day before yesterday, found the buildings in very poor condition, and that vandalism had taken a heavy toll of equipment that had been stored inside the Operations building." Eventually, the myriad problems were resolved one by one—water supply, radio frequencies, shelter and food, heating and many more—and the job was done.

In the fall of 1952 a writer for the Baltimore Sun and The Johns Hopkins Magazine sought permission to visit the ARL and report on that facility which was being operated by the University. The SDARL, who was

at Stanford University and not physically at the ARL at the time, objected strenuously to the visit on two grounds. First, the SDARL would not be there and, therefore, the writer could be given no proper briefing on the research program. Secondly, the visit would be in the Alaskan winter when the research would be at a low ebb and, hence, an erroneous impression of the research and its importance might be given. Apparently, the SDARL was overruled, for the reporter did go to the ARL in November and produced an article called "Probers of the North". The available record is not clear on the point, but apparently the article was published. The University felt that he had done an excellent job.

At the end of 1952 the official record showed that for the first six years of its operation the ARL had spent —

For logistic support -----	\$520,072
For air support -----	\$109,495
For plant administration -----	\$347,891
	<hr/>
Total	\$977,458

Of the above, the ONR was repaid \$140,295 by the NOL, the Bureau of Yards and Docks, and the Air Force. Thus, ONR support funds had been used to the amount of \$837,163. The amounts are all exclusive of the costs of the research projects. For the 1952 calendar year alone, the cost was —

For logistic support ----- \$ 97,604

For air support ----- \$ 37,608

For plant administration ----- \$ 89,719

Total \$224,931

In 1952 ONR was repaid a total of \$39,330, mostly for support of Projects Lincoln and Ski Jump II.

The monthly newsletters of the ARL that recount day-by-day happenings of interest give a good feel for life at the ARL and elsewhere in the Barrow vicinity. The following illustrates the point—

"2 January. Work in #251 continues, with the jacking up process just about to begin. There are only catwalks of 12-inch-wide planks running the length of the hall now, so it requires careful footwork to negotiate the trip from the shop to the dormitory . . .

14 January. The aurora borealis put on a particularly brilliant display last night. No crackling or sizzling, as it is said to do now and then, but lots of blue-white, pale green, yellowish and some rosy tinted gossamer curtains undulated across the sky from horizon to horizon . . .

20 January . . . The sun was supposed to come up for twelve minutes today, but there was too much haze close to the horizon for it to show through. All to be seen from Barrow was the colorful bank of clouds in the south for a couple of hours during the middle of the day. Temperature down a trifle—minus thirty-two at 0730 . . .

April 15. Pete (Pete Sovalik, one of the Eskimo workmen) reported this morning that two crews left the village to set up their whaling camps on or near the lead (stretch of open water in the sea ice). Pete said they and the others in the Village were greatly excited about the coming season and all are hoping for many whales and an abundance of muktuk (whale skin, an Eskimo delicacy) . . .

April 24. Great excitement reigned in the Barrow Village about midnight last night. When the people came out of the theater, a very large polar bear was seen on the beach less than a hundred yards away. No one had expected such a visitation so guns were not readily available, and when guns were found the proper ammunition was not at once at hand. The result was that the polar bear took off toward the north at a steady lope without a shot being fired until he was at such an extreme range that the fusilade was ineffective. Apparently the firing served merely to spur him to greater effort and he nearly ran over two Eskimo men returning to the Village from one of the whaling camps . . .

April 29. Whales, whales, whales and still more whales! We learned at breakfast this morning that a second whale had been killed during the night and all cut up during the night. At coffee time, 9:30 A. M., more excitement marked the arrival of word that a third one had been taken . . ."

With the official word in early March, as previously reported, the ARL had to adjust to a local situation that began to change almost immediately. By June 1 with a tone of desperation the SDARL wrote Dr. Quam

in ONR—"Things become more involved and confused daily. The latest is that there is a very high probability that the Navy will cancel its contract with Alaska Airlines at the end of this month, and that from the 1st of July on other agencies, such as ARL, will have to make direct arrangements with Wien Airlines—or some other carrier—to handle freight and passengers between Barrow and Fairbanks!" Two weeks later the SDARL informed the DNPR that with only a few exceptions, the ARL investigators will have left Barrow by September 15. He said—"It is the policy of the personnel at the Arctic Research Laboratory to cooperate in every way possible with the Arctic Contractors and with the Naval Representatives at Barrow in facilitating close-out operations. There will be no attempt made to urge the Arctic Contractors or the Navy to provide facilities beyond the 15th of September, and full cooperation will be extended in bringing about an orderly and complete close-out . . ."

By the latter part of July the SDARL was able to set forth in a long memorandum to the OICC some of his understanding of the details of ARL operations after October 1, 1953. He covered such items as custody of buildings, heat, water, steam, investigators to remain at the ARL, their living arrangements, status of The Johns Hopkins University contract, handling of sanitation, etc. He included the following sentence—"It is believed that the Laboratory will be reopened for active research programs in June 1954 and that it will continue to serve science, the military services, and the people of the United States for many years."

At that time the situation in regard to ARL was fluid in Washington also, and Dr. Quam, who had been handicapped by a period of poor health, was doing his best to keep the SDARL up to date. On July 24 he guessed that the decision would be to adopt a minimum program and continue to try to enlist Army and Air Force cooperation in support of a larger program. He thought the decision would be made soon on the level of operation. He hoped that Dr. Wiggins could be persuaded to continue as SDARL and that Stanford University might take over the contract. His guesses were confirmed in a meeting in the office of the CNR, RADM Bolster, only a few days later.

On August 1 Project Keys (an Air Force project) asked that two men be given messing and billeting at ARL to mid-December and again in the late winter and spring of 1954. In a long letter to ONR, the SDARL asked for some decisions and made his recommendations. He proposed—

1. That the main ARL buildings be put on a standby basis.
2. That the shop be made available to the Geological Survey party that was to remain.
3. That the heavy outside equipment be loaned to the Geological Survey. This included tractor, fork-lift, weasels, drilling equipment, etc.
4. That the Aerology Laboratory be turned over to the Survey group.

5. That an Eskimo be retained as a custodian.
6. That the Survey group be self sufficient as to services and logistics.
7. That the Keys Project men be authorized to stay but that they also be self sufficient.
8. That the SDARL retain control until a new contract is entered into.
9. That on January 1, 1954 control pass from The Johns Hopkins University to another contractor.

Also about August 1, the OICC recommended that the gas well at Barrow not be plugged, but just shut off in view of the possibility of the ARL reopening in 1954. As the summer wore on, the SDARL became increasingly concerned about the high cost of bush flying. In anticipation of later needs, ONR in August began looking for excess weasel parts anywhere in the Services for the weasels that would be left at ARL by the Pet 4 operation.

By August 11 Dr. Quam felt that the Keys Project men should be accommodated if at all possible, in part because ONR was trying to obtain Air Force cooperation in keeping the ARL on a year-round operating basis. He also hoped a central mess could be maintained. He said that he thought ONR could support a cook, custodian, and perhaps an Eskimo helper.

The Deputy CNR on August 13 informed the OICC that the decision had been made to keep the ARL open on a minimal basis. He stated that

it did not seem feasible for ARL to maintain and operate the camp to provide facilities and services to other possible users. Also the ARL program could not operate the power plant or the gas well. He did offer ARL's cooperation if anyone else wished to provide services.

And so as the deadline for Pet 4 closing drew closer, more and more pressure was brought to bear on ONR. A wire was sent to the SDARL on August 17 informing him that the Coast and Geodetic Survey wanted to keep an observer at Barrow if housing and meals could be supplied. BUDOCKS was urging ONR to provide facilities for the Geological Survey permafrost group and the Air Force Keys personnel. The SDARL was asked to try to make some arrangements, and he was told that funds were available.

He wrote back immediately---"It appals me to think of the myriad things that MUST be done in the next three weeks if this enlargement of the 'minimum' program approved a couple of weeks ago is to be carried through!" He felt that the original plan "might have worked out after a fashion. But, when one begins to plan on the basis of being landlord to about ten to fifteen people from three or four different agencies, he is dealing with another program entirely! Add to that the fact that a great deal more in the way of upkeep of equipment, oversight of the buildings, servicing for fuel and water of five or six instead of two buildings, and the fact that the Arctic winter is no picnic for even experienced personnel, and one comes up with a tremendous increase in complexity of operation."

On August 24 the Deputy CNR officially invited Major General D. N. Yates, Director of R and D, USAF to participate in the full use of the ARL.

The SDARL immediately started to prepare for continuation on the expanded-minimum basis. At the end of August in two detailed letters, he informed The Johns Hopkins University of the changed situation and predicted that by the end of 1953, just about every cent of money in the University's contract would be expended. Early in September he reported to Dr. Quam that the new plan was progressing well with only a few unexpected problems. He also reported three more tenants if their stay at ARL is authorized--a Bureau of Standards representative and two Air Force assistants.

During the several months of the changeover interval in 1953, the SDARL was alert to the opportunity of acquiring all sorts of items from the Pet 4 operation which otherwise would be returned to the States in the 1953 ship expedition or would be stored in secure warehouses at Barrow. Many thousands of dollars worth of items were requested and obtained. These included all sorts of heavy outside equipment such as trucks, cranes, tractors, weasels, heavy sleds, and also machine tools, shop equipment of all sorts, hardware, and food and clothing stocks.

As of May 31 the air support for 1953 had cost ARL \$7426. Of that amount \$3369 was the cost of air support for Project Lincoln and not regular ARL support. As of that date, \$16,478 was left in the air-support account for use during the remainder of the operation under BUDOCKS

support. As of the close-out date of Pet 4, \$6416 was left in the air-support account, and through the effort of the SDARL, this was recovered by ONR from BUDOCKS.

As of July 31 other support for 1953 amounted to \$46,746, of which \$9606 was for Project Lincoln and \$291 for Project Aurora. As of that date \$5650 remained available. As of early September and in the light of the figures just cited, the SDARL felt "that an additional \$10,000 or \$12,000 should see us through the close-out as far as expenditures carried on by the Arctic Contractors and the Bureau of Yards and Docks in our behalf are concerned". As of September 30 there remained an unexpended balance of \$3050 at the close of Pet 4 operations.

During the difficult summer of 1953, while all the problems of the impending Pet 4 close-out were pressing with ever increasing urgency on the staff at ARL, it was necessary, of course, to continue to support the research program as effectively as possible and to handle the myriad day-to-day crises that continued to arise. A researcher had his personal outboard motor stolen by a local resident, and the SDARL felt obligated to attempt officially to obtain a replacement for him--a difficult matter in government. A researcher from another Navy organization in California, and who had previously been at ARL and should have known better, tried to return without clearing through ONR in Washington, or getting ONPR permission to enter Pet 4, and without coordinating with the SDARL. He had

to be brought into line. It was necessary to explain to the group of scientists who would be working from a Navy icebreaker in the Arctic Ocean that the shore support available in earlier years through ARL would have to be much restricted in 1953 because of limitations imposed by the close-out. So it went—and through it all, the SDARL maintained a remarkably calm and controlled exterior, and the jobs were done.

A report of SDARL for the financial year beginning July 1, 1952 contains a paragraph about some ARL staff members and is a useful summary—"Several changes in personnel at the Arctic Research Laboratory occurred during the year. Mr. S. Wheeler Edwards resigned as secretary in August (1952) and was replaced by Mr. William Tyner, who also resigned as of 30 September in order to return to medical school. He was replaced by Mr. J. Walter Findlay, who was promoted to Assistant to the Director on 1 January 1953, when Mr. Robert Johnston completed his year of service and returned to the central United States to go into business with a friend and former associate. Mr. Frank Talbert, who had been Shop Foreman since early 1950, was in poor health during the autumn and early winter of 1952-53 and returned to California on 6 January, for a medical check up. He was advised by his physicians to resign from the northern post, a course which he followed in mid February, 1953. Mr. R. H. Ames became the Shop Foreman on 1 April and his wife, Alberta Ames, took up the secretarial post that had been vacant from the first of the year when

Mr. Findlay assumed the office of Assistant to the Director. Mr. Findlay suffered an attack as yet undiagnosed on 24 June and left Point Barrow for medical attention in California on 30 June. His vacant place was filled by Mr. George E. Lindsay, who had been Administrative Assistant in charge of the Umiat Laboratory during the summer of 1952, and who had come to Point Barrow to aid with the normal operations of the ARL during the summer of 1953."

ARL - TO BE OR NOT TO BE

Ted C. Mathews became Director of the Arctic Research Laboratory on February 1, 1954 with the effective date of the ONR contract with the University of Alaska. The Johns Hopkins contract was not phased out until the end of March, so for two months both contracts were running. This meant chiefly that Johns Hopkins continued to meet the local (Pt. Barrow) payroll and certain other expenses.

The year 1954, which encompassed all of the 10-month Mathews administration, was one in which the continued existence of the Laboratory hung in the balance. The decision had been made in 1953 to keep the facility open on a reduced basis through the winter months, and research-project applications were in the administrative mill awaiting final decisions. The Laboratory had been located at Point Barrow in the first place, precisely because the Pet 4 operation had provided the facilities and offered the logistic capabilities needed to support a research program. It had been foreseen earlier that the eventual close-out of the oil operations would precipitate a crisis for the research program. As was reported by Dr. Quam on March 31, 1954 to a meeting of a subcommittee on the Arctic Research Laboratory established by the Arctic Institute, the Department of Defense had been having a critical look at all Government military research. The decision had been made to operate the Laboratory on a reduced basis through the 1954 program and that program was in motion. The

long-term future of the ARL remained vulnerable to shifts in policy, however, and by no means was assured.

The uncertainties in Washington were compounded by the necessary contraction in operating facilities at Point Barrow. Ted Mathews was an engineer, not a scientist, as was indicated in his title of DARL, not SDARL. The morale of the scientific investigators who worked at ARL during the year could not but be adversely affected by the changes that had occurred. The whole operation reached a low ebb, but, most important, it remained alive.

For Mr. Mathews and the University of Alaska the 1954 experience, for many reasons, was not as successful as had been anticipated. By the end of the year a change was being arranged in the administration at Point Barrow, determined largely by new requirements from Washington.

New Guidelines for the Research Program

Also at the first meeting of the Arctic Research Laboratory Subcommittee of the Arctic Institute, Dr. Quam, who spoke at some length, set forth the desires of the ONR on the future use of the Arctic Research Laboratory. A clearcut Executive Order had designated the National Science Foundation as the principal source of funds for "basic research". Dr. Quam affirmed, however, that military research funds (within which the ONR operated) were to support "such basic research as is relative to the military". It was in that area, he said, that the ARL was to operate and it was specifically so stated in the directives.

Dr. Quam pointed out that within ONR three branches would be sources of funds for the Laboratory. These were first and largest, the Geography Branch. Another was the Biology Branch, and the third was the Physiology Branch. He estimated that for 1955 there would be available research funds of about \$60,000 from the Geography Branch and perhaps about \$20,000 each from the other two branches.

Dr. Quam explained that there were three categories of support given by ONR for research at Barrow. The largest part would be spent through the Arctic Institute of North America. A second category would be projects which ONR would support directly without going through the AINA. He mentioned shore-line and soil-mechanics projects. The third category would include projects jointly sponsored by ONR and other segments of the Navy or other agencies. As examples of the latter, he mentioned the permafrost study jointly sponsored with the Geological Survey and the terrestrial-magnetism work done under the Coast and Geodetic Survey.

As a guide to the Arctic Institute, Dr. Quam set forth some general "rules" which the ONR wished the Institute to follow in planning its ARL program. First, it was desirable that research programs be favored which could utilize the Laboratory in winter as well as in summer; second, projects which could be carried out as well or better elsewhere should be placed elsewhere; and third, wherever possible, Barrow projects should

be coordinated with those at other arctic stations such as the Canadian Defence Research Northern Laboratory at Churchill. Within those general rules the ONR wanted a basic research program for the ARL.

It also was agreed that a shift of emphasis was in order, in general, away from the biological sciences. Priority ratings were agreed upon, as follows:

First, earth sciences (such studies as permafrost, geomorphological processes and their resulting landforms, and engineering problems in soil mechanics and hydrology).

Second, sea-ice studies (its properties, thickness, movements, etc.).

Third, meteorology and studies of the atmosphere.

Fourth, a group of fields in biology, anthropology, and related sciences. Within that group, hydrobiology would stand at the top. Entomology, plant and animal ecology, physiological studies, and the psychology of native peoples would rank lower. However, it was noted that such lower rated studies could be supported at Barrow with AINA funds other than ONR funds, provided space and facilities at ARL were available. Space was said to be available for from 12 to 15 research workers in winter and up to about 30 in summer.

At this first session of the ARL Sub-Committee it was further agreed that the field work might be done by qualified graduate students.

In such cases it would be desirable that their work be directed by mature men of recognized attainments. Canadians as well as Americans would be welcomed, and it was agreed that the planning of the program should be done with as much collaboration as possible between the AINA and the University of Alaska.

Within ONR a new committee had been set up to guide the research program of the ARL. The Research Group Committee on Arctic Research Laboratory at Point Barrow was established by ONR memorandum of March 2, 1954, which designated the Geography Branch to continue to administer the Arctic Research Laboratory Project. The memorandum stated that "it is planned that the research program will encompass all fields of science that can profitably be conducted at an arctic laboratory." To advise and assist the Geography Branch in developing an interdisciplinary program, the Research Group Committee was designated. It included representatives of several branches (Biology, Physiology, Geophysics, Geography, Nuclear physics, Power, Psychological sciences, Amphibious warfare) with Dr. Louis O. Quam of the Geography Branch designated Chairman.

The second meeting of the ARL Sub-Committee of the Arctic Institute was held on May 13, with several of the members of the ONR Research Group Committee on Arctic Research Laboratory present, including Dr. Quam. At that session John C. Reed, L. O. Colbert, and Joseph T. Flakne

reported on the progress of their efforts to find suitable research people and projects for the Barrow Laboratory during the coming winter and summer season 1954-55. The three men reported considerable effort and promise of results from their contacts with university and other agency authorities. Dr. Quam reported that of 19 arctic research projects approved for 1954, which he listed, 16 would be carried out at Point Barrow during the imminent summer. Of those, nine were being supported through the Arctic Institute.

At that meeting Dr. Quam outlined his conception of the way in which applications from researchers would be processed. He looked upon the process as a joint operation involving the ARL Sub-Committee on the one hand, and his ONR Research Advisory Committee on the other. The ONR Committee would help advise him on the scientific merit and the Naval applicability of various problems and projects. The committee would also ferret out Naval arctic problems within the Service that could be attacked at the ARL. Proposals for research from outside the Navy should be sent directly to the Arctic Institute. He believed that the major part of the Research Laboratory work would be arranged through the Institute, with the ONR handling some proposals directly.

Further discussions of specific areas of research at the Sub-Committee meeting did not result in any changed directives. Psychological research received some inconclusive attention, and hydrobiological

research efforts were summarized. At that session Dr. Quam referred to plans that were being made for the International Geophysical Year to cover a period of 18 months in 1957 and 1958. He said that Barrow was mentioned in the American plans, especially for studies of air glow and radio propagation, and perhaps for studies of cosmic rays. He did not anticipate that Barrow would be involved to any great extent, but the problem of coordination already was being discussed.

At the next meeting of the Arctic Research Laboratory Sub-Committee held in New York on October 21, 1954 Dr. Quam again emphasized that although the ONR attitude toward arctic investigations naturally was influenced by the basic mission of the Navy, the "prevailing policies included no prejudice for or against investigations in a particular scientific discipline." He noted again, however, that biological studies had been represented heavily at ARL in the past and that his interest in encouraging research in the earth sciences and in the field of hydrobiology arose from a desire to establish a more evenly balanced program. At this meeting also, there was positive but indecisive discussion of a possible visit to communities and establishments in the North, with a view to assessing research possibilities. Dr. Quam reported that he had informal concurrence for such a visit from the Chief of Naval Research. Admiral Colbert of the Arctic Institute was asked to pursue the project with the proper authorities.

The Research Program in 1954

The research program at the ARL in 1954 was reduced in scope and in numbers of investigators as compared with earlier programs. Many of the 1954 projects were continuations of investigations begun in previous years. The researchers concentrated their field work during the summer, and many remained for a relatively short stay. About 25 investigators participated.

Nine of the 1954 field-research projects at Point Barrow were ONR supported through Arctic Institute subcontracts. Among them were the continued investigations of John L. Mohr, whose project title was "The Ecology of Arctic Crustaceans". He was assisted in 1954 by Emory Swan during their stay at the ARL from July 24 to September 4. This was the third summer the University of Southern California project had been active at the ARL.

Professor Daniel Q. Thompson, from the University of Missouri, returned for a short week in August to complete his field study of lemmings. His project had continued through the summers 1950-1953.

Another returning group was that of Professor Norman J. Wilimovsky of Stanford University, who had begun his Alaskan investigations of the fishes of the area in 1951 and had returned each summer since. In 1954 he was assisted by H. Adair Fehlman and by Daniel M. Cohen for the season (June 14 - September 4) conducting a broadened study of nutrient

content of ice-melt waters and sonic studies of the waters of the continental shelf.

Donald E. Wohlschlag, also from Stanford, and also investigating fish, in his case studies of population dynamics of isolated, unexploited fish populations, returned to Point Barrow on a project he had inaugurated in 1952. In his 1954 summer investigations he was assisted by Warren Freihofer.

An investigation of the "Littoral Sediments of the Point Barrow Area", which a Stanford project had initiated in 1952, was picked up again after a year's recess. Robert Rex, who had led the field party in 1952, returned to the ARL at the end of July 1954 with Mrs. Rex, and for a month they continued work on geochemical studies of lagoon sediments.

Four of the AINA supported 1954 projects were new. They included Adam Bursa's "Study of Phytoplankton" which he pursued for the three "summer" months, departing on September 8; G. Dallas Hanna, from the California Academy of Sciences, who arrived in mid-June to investigate the geology of the continental shelf in the area; Dr. and Mrs. Richard McBee, who were late arrivals at the end of August, completing their investigation of "Thermophylic bacteria in soils" in about two weeks and departing September 15; and lastly, Joseph Sonnenfeld, geographer from The Johns Hopkins University, who arrived in May to study the economy of the Eskimos in the Barrow region.

In addition to the research projects arranged through the Arctic Institute, a number of investigations and research operations continued from earlier years. One of these was the Arctic Ice and Permafrost Project which was supported by ONR, BUDOCKS, The Army Corps of Engineers, and the Geological Survey. Investigations out of the ARL had been started by the MacCarthy's in 1949, and in 1954 were being continued under the direction of Max C. Brewer. The project involved winter as well as summer investigation and was active through the winter 1953-54 with S. J. Odend'hal and William T. Maher in residence at the ARL. During the year Brewer spent part time at the ARL, himself, and also brought in Wayne Bruce to replace Odend'hal, when the latter departed in August.

A second permafrost investigation, that one an "Ecological Study of the Permafrost", was carried on by Dr. and Mrs. Gerald R. MacCarthy, who arrived on July 5, and continued their tests and observations of the electrical properties of permafrost until their departure on December 18.

During 1954 ONR sponsored a project at Barrow on "Shoreline Morphology and Studies of Beaches" under Marshall Schalk. He and his assistants were at the ARL for the two months, July 2 to September 14.

Also under ONR sponsorship, Max E. Britton from Northwestern University renewed his investigation into "Reciprocal Relationship of Vegetation and Physical Environment in the Alaskan Tundra."

Two investigators from Iowa State College, Ames, were at the ARL during the week August 4 to 12 under an ONR contract to determine the "Engineering Properties of Glacial Deposits".

The Coast and Geodetic Survey geomagnetic observations continued throughout 1954 at the magnetic observatory under the operation of Richard Green and after his departure on June 14, of Bernie Wider, his replacement.

During 1954 the Laboratory also provided support for two classified projects; one, the "Keys Project" sponsored by the Air Force through Boston University with John Merrick as the field investigator, and the other an "electronics" project, also of Air Force interest, administered through the National Bureau of Standards. Don Waters, investigator, was at the ARL from February to May 21. Prior to the arrival of John Merrick on March 26, the Keys Project had been serviced by Odend'hal and Maher of the Brewer permafrost team.

During the last half of 1954 another investigation, of a preliminary nature, was undertaken by investigators under Dr. Elvey working out of the Geophysical Institute at the University of Alaska. That project involved investigations into the local conditions affecting radio propagation. Robert Leonard and M. Young began the activity which was expanded into the operation of equipment installations for both radio-propagation and aurora-research programs. An auroral camera arranged to photograph the sky once each minute was set up.

In November 1954 a seven-man team from the Air Force Aero-medical Laboratory at Ladd Air Force Base arrived for the purpose of conducting the first phase of arctic survival and physiological studies. After a three-week stay the team departed with the expectation of returning the next February to continue the special project. Alan Innes-Taylor was the field-team leader.

The Laboratory also was host to an Air Force four-man radio-study team, headed by George Moore. The special team departed November 20.

A fifteen-man Air Force team arrived in September to carry out certain classified investigations while receiving logistical support from the ARL.

Administration of the ARL in 1954

On November 27, 1953 Dr. Ernest N. Patty, President of the University of Alaska, submitted the University's proposal to take over the operating contract from The Johns Hopkins University. In submitting his proposal Dr. Patty emphasized his heavy reliance on Dr. C. T. Elvey, Director of the Geophysical Institute at the University, and on Ted C. Mathews, an engineer who had had experience at Barrow with the Arctic Contractors. In fact, Dr. Patty wrote, "If he had not been available and vitally interested in the Barrow area, I don't think we would have submitted this proposal to you".

The University of Alaska proposal was not the only one submitted. In an internal Navy memorandum dated January 19, 1954 ONR cited the University of Alaska bid of \$155,700 and compared it with the other bids that had been submitted by the Arctic Institute, the University of Southern California, and the California Academy of Sciences of San Francisco. The choice of the University of Alaska bid was explained on the basis that it had "submitted the lowest bid" and also "has adequate trained personnel who are familiar with the problems of this area, and are located in the general vicinity of the Laboratory".

In a letter to Dr. Quam of January 9, 1954, the retiring Scientific Director, Dr. Wiggins, expressed his concern and doubts regarding a University of Alaska contract. He questioned whether a "bargain basement" contract might not, in the long run, turn out to be a poor bargain. What concerned him and troubled him was that "If the University of Alaska is to be concerned solely with the operation of the laboratory, from a logistic standpoint, who is going to handle the decisions about scientific apparatus, equipment, supplies, allocation of such equipment to different teams, the recruitment of new projects, advice to the scores of individuals who write questions to the ARL each year, etc. ? In other words, don't you think a scientist is needed as a part of the operational staff at least during the busiest part of the year, namely the summer season? Such a person should be on a part time basis during the rest of the year, in my opinion,

to help keep track of supplying the needs of the investigators working at the laboratory and to aid in making new contacts and in evaluating the results of the efforts exerted by the people sent to Barrow." It is evident from the record of Dr. Wiggins' own administration that his doubts grew out of his own experiences and activity during his incumbency as Scientific Director. As such, he had been involved in making "scientific" judgments and decisions, not only business and operational management decisions. He was clearly worried that the dropping of the "Scientific" aspect of the Directorship would be a serious handicap for the whole operation.

ONR presumably was aware that the appointment of a "non-scientific" director of the ARL placed greater responsibilities on the Washington end to recruit and guide the scientist investigators. At the meeting of the Arctic Institute's Arctic Research Laboratory Subcommittee on March 31, 1954, it was agreed that the planning of the research program should be done with as much collaboration as possible between the Arctic Institute and the University of Alaska. At the same meeting certain members of the subcommittee agreed to look for projects and people in their respective areas of interests—Admiral Colbert in meteorology and studies of sea ice; John Reed in the earth sciences; Joseph Flakne in the engineering field. It was also suggested that Rear Admiral E. H. Smith should be asked to serve in the same capacity in the area of sea-ice research. Mr. Flakne agreed "to develop the necessary relationships with the University of Alaska" which were thought to be of particular importance.

The ARLAB, which earlier had performed such valuable services for the research program, was gone with the end of Pet 4. The new machinery which used the services of the arctic research "know how" of the Arctic Institute was not yet in full swing.

The supervision of the Laboratory operation during 1954 at the ONR end fell largely on the shoulders of Dr. Louis O. Quam, Head of the Geography Branch. The files indicate that the normal headaches of meshing the plans, projects, and travels of the researchers with the staff at Point Barrow continued as before. In a letter of June 24 to Director Mathews, Dr. Quam mentioned, for example, new security regulations on travel which had resulted in swamping the clearance agencies and greatly increasing the difficulties of getting travel orders out on time.

In April Dr. Quam reported to Mathews that ONR was being asked to inform the Office Naval Petroleum Reserve (ONPR) what specific buildings and equipment at Point Barrow the ONR wished to retain for ARL operations, since ONPR had declared all its properties there as surplus. Mathews took the position that all buildings and equipment except oil-field supplies and equipment and Fairbanks office equipment should be requested by ONR. Dr. Quam in a letter of May 6, 1954 indicated that that approach seemed impracticable and asked Mathews to furnish a list of the buildings and equipment which he felt could be justified for retention for ARL on the basis that, although there might be special operations at

ARL during certain years, ONR did not contemplate any large expansion of the research program. Mr. Mathews then submitted his list, and the transfer was accomplished by ONR and ONPR. Later in the year a request by the Territory of Alaska for the transfer of certain items to it was fielded by eliciting a telegram from Mathews stating that surplus items did not exist. In a letter of October 1, Dr. Quam informed Dr. Patty that the Navy Bureau of Supplies and Accounts was preparing to dispose of the property of ONPR in northern Alaska, and that the Chief of Naval Research had, therefore, ordered a review "in terms of present and planned operations for a three to five year period". The pressure on ONR to reduce its inventories at Point Barrow was eventually blunted by Ted Mathews' plea, by letter of October 10, in which he pointed out the several projects being planned by the Air Force and the Army which would rely on ARL for support. He recommended that the inventory at Barrow not be reduced. Dr. Quam's letter to him of November 5 included the statement that "the Admiral has approved our retaining the equipment we now possess." Other events had overtaken the drive to reduce ONR inventories at Point Barrow.

On July 19 Dr. Patty was informed that the Geography Branch of ONR had approved an extension of the contract with the University of Alaska and that a representative of the Contract Division would contact the University business office to negotiate the extension. This was later accomplished, and the basic contract was extended for the period February, 1955 to January 31, 1956 in the amount of \$160,000.

In the exchanges between ONR and the ARL concerning the disposal of inventoried items which had been touched off by the demands for inventory reduction, certain developing Washington plans began to emerge. Ted Mathews' October 10 letter, above cited, outlined for Dr. Quam the support demands on ARL which he foresaw as existing, imminent, or looming. He cited the presence at the ARL of a 15-man Air Force group, and another 4-man group working on radio propagation. The 15-man group, he reported, had expressed a desire to continue its operation for another three months and was planning a permanent operation of possibly 20 men. A 7-man team from the Arctic Aeromedical Laboratory at Ladd Field (Fairbanks) was planned for November to begin work on arctic survival and environmental studies. That group might expand to 15 to 20 men on a continuing basis. The Bureau of Yards and Docks, he reported, were planning a 40-man group which might desire to locate at Barrow. In addition, the Army Map Service had sent people to the ARL to inquire into "the possibility of support for 140 men, 6 fixed-wing aircraft and 6 to 8 helicopters to be used in their project—mapping the area north of the Brooks Range."

Lastly, Mathews reported that the previous week he had been visited by Air Force and Western Electric people to inquire about the facility. "This visit," he wrote, "was timed with the newspaper announcement that the aircraft warning network would be extended along the arctic and Bering

Sea coast." He foresaw that Barrow would become a central point for construction, which could very well mean a construction team of 200 to 300 men. His foresight was good, if too modest, as soon became evident.

President Patty visited Washington in November, and in his consultations with ONR mentioned that Ted Mathews was leaving his DARL position. The question of a replacement became imminent and was discussed by the AINA Advisory Committee on the ARL which met in Montreal on November 18 and 19. The names of Drs. Hanna and Wilimovsky were proposed for transmission to President Patty. Ted Mathews departed the ARL on November 23 on his way to Washington.

Meanwhile, the wheels in Washington moved quickly toward a drastic change in the setup at Point Barrow. At the same time a replacement for Ted Mathews was being sought by the University. President Patty stopped in California on his way back to Alaska, and on November 28 called together a group at the home of Dr. Ira Wiggins for discussion of a new director, as well as other ARL problems. Interestingly enough, the leading prospects for the position were all present. Besides Wiggins himself, there were present at the discussion G. Dallas Hanna, Curator of the California Academy of Science; Maxwell Britton of Northwestern University; and Norman Wilimovsky from the Natural History Museum, Stanford University. Present also were Max C. Brewer of the Geological Survey and Siemon Muller, geologist, of Stanford. The record of the discussion did not indicate any

conclusive preference among the candidates being considered, but there was general agreement that the resident Director for at least part of the year should be a recognized scientist and that a station manager to be subordinate to the Scientific Director should be selected, preferably by the Director himself.

Discussion at the meeting at Dr. Wiggins' home indicated some awareness of the problems that would follow if one or two large construction companies were to come into the ARL area.

On December 6, 1954 a meeting was held in Washington, D. C. attended by 21 representatives of the interested military services and other agencies, as well as of Western Electric Company, and attended also by Ted Mathews, DARL. The meeting resulted from a request to ONR by the Air Force Research and Development Command for permission to utilize buildings and equipment at Point Barrow to support Project 572 (DEW Line). At the meeting it was "agreed that on receipt of a formal request from the Department of the Air Force the Department of the Navy would 'permit' the base at Point Barrow to the Air Force and that the Air Force would provide logistic support for the Arctic Research Laboratory." Because of the urgency of the Air Force mission, it was agreed that details would be worked out at another meeting the next day.

At the December 7 meeting, agreement was reached on the following:

- a. The ONR to transfer to the Air Force the supplies and

equipment held at Point Barrow and to permit to them the buildings other than the ARL (including power plant, heavy-duty shop, mess hall, laundry and other service buildings).

b. ONR to retain enumerated buildings plus six wanigans, the magnetic station, radio-range mast, Barrow remote radio receiver, former AACS receiver and former CAA transmitter and antenna; also reserved to ONR a small designated area in the vicinity of the Laboratory.

c. The Air Force and its contractor, Western Electric, agreed that scientists should be free to conduct research at the base, on the shores, on the ocean, and in the interior of northern Alaska, and agreed to provide logistic support for the ARL free of cost. The specifics of this obligation were spelled out.

d. ONR to limit research scientists to 60 in the summer and 30 in the winter season; meals to be furnished at \$5.75 per day.

e. The Navy to permit the air strip and hangar facilities to the Air Force; Air Force to negotiate an agreement with Alaska Air Lines and ONR to terminate its agreement with CAA.

f. The Air Force Research and Development Command to take over all personal property listed in the inventory of September 17, 1953 except weasels, arctic clothing and certain other items.

The agreements reached on December 7 were quickly formalized. Two days later President Patty was informed by letter of the essential

terms of agreement, and that the Air Force contractors, the Western Electric Company and Puget Sound Drake Company, must begin immediately a construction program at Point Barrow and vicinity involving 400 to 500 men. The terms of the agreement outlined in the letter followed the terms of the December 7 agreement except that the maximum number of scientists at the ARL during the winter months was stated to be 25, not 30. President Patty was informed that the contract officer and Mr. Mathews would work out the details for modification of the University of Alaska contract for operation of the ARL.

A CAA memorandum to its Regional Administration, Region Five, outlined specific plans, chiefly those affecting CAA, but also indicating that preparation for construction would get underway immediately and would be in full swing at Barrow by the middle of February. The construction force of 400-500 men would be mostly employees of Western Electric's subcontractor, the Puget Sound Drake Construction Company. Construction would require an estimated two years, after which the Point Barrow base would continue to be the logistic base for the completed facilities. The memorandum mentioned that the subcontractor was expected to operate the base, including the landing area, in a manner similar to the previous Pet 4 operation by Arctic Contractors.

The paucity of records precludes a detailed account of the local administration at Point Barrow under the directorship of Ted Mathews.

As was asserted by Dr. Wiggins and others, during the year Mr. Mathews had been confronted with a new and difficult assignment at a time when conditions were uncertain at best.

The ARL Monthly Reports, which had been supplemented with lively and revealing monthly newsletters during the MacGinitie and Wiggins administrations, were reduced to brief and incomplete reports which gave only modest insight into the local developments. Correspondence between the Director, Dr. Quam, and others provides some index of specific problems that were handled, but also fails to give an insight into the day-to-day life at the Laboratory.

In his progress report for February 1954, Mathews reported that his visit to Washington and to universities and institutions had been followed by an inspection of the Point Barrow camp by Ira Wiggins and Louis Quam of ONR, who accompanied the Director back to Barrow. Office space in Fairbanks was taken over for ARL use.

In April the gas well, which had been closed down the previous fall, was reopened and was reported as heating a majority of the buildings in use.

Local transportation continued to be a concern of the Director. In February, he reported, an inventory of weasel parts was checked; in April a program of weasel and jeep overhaul was undertaken; and in May additional weasel parts were ordered. Subsequently, a problem of

securing transportation and delivery of those parts arose. Since the Navy summer supply ship was cancelled, Director Mathews began correspondence looking to transportation from Seattle via the Department of the Interior ship, North Star.

Maintenance problems apparently plagued the ARL in 1954 as they had previously. The May Progress Report contained an account of difficulties with the waste line running from the Laboratory to the beach. According to the account, it took "three men's time approximately four weeks to thaw out the line and repair the breaks which were occasioned when the line was shut down without proper draining".

The Monthly Reports also indicated a high rate of turnover among ARL employees, plus an additional burden resulting from the illnesses of the power plant operator, who had been supplied by Wien Airlines, and of Mr. Morgan Nordkvist, ONPR custodian, who was authorized six weeks' leave in May and who "voluntarily quit" on August 20.

The Magnetic Observatory, which had been operated by the Coast and Geodetic Survey, was transferred to operation by the Geophysical Institute of the University of Alaska on July 1. During the early summer a water-treatment system was set up in a water wanigan, for use after the breakup of the fresh water lake. During June-July the central mess hall underwent "conversion". Inventory problems, with resultant checks and rechecks were frequent, due in part to changing requirements from Washington and in part to Mathews' initiative.

The ARL reports, especially for the peak summer months, indicate that considerable time and attention were devoted by the Director to the entertainment and education of VIP's and other visitors. In August, he reported, there was "a steady stream". Among the many mentioned in successive reports were Secretary of Interior Douglas McKay, Assistant Secretary Felix Wormser, Geologists Parker Trask and Jeffrey Kellaway, Author George Stewart, Mrs. Lawrence Cumming (Betty Crocker of General Mills), James Ball of the ONR Contracts Division, Contract Administrator W. B. Girkin, Dean Neil Hosley of the University of Alaska, plus numerous others from defense agencies.

According to the reports, nearly all of the visits were appreciated and were successful from the ARL standpoint. Three special cases may be mentioned. One of these was Betty Crocker who, he reported, "was equally interested in Fred's cooking and the Eskimos' methods of preparing their bill of fare". Apparently she was a much appreciated visitor. Regarding the Trask-Stewart visit, Mathews reported "a good initiation into the trafficability problems in the Barrow area was dished up for them by taking them out on the tundra in an LVT and getting thoroughly stuck. This was not intentional, however. This season we have had about six inches deeper thaw in the area, and the Director did not make allowance for this additional thaw in taking them over the terrain. The end result was quite successful, however, since it was necessary to get a weasel

and a D-8 cat out to free the LVT, and Dr. Trask got a good idea of how the three vehicles behave during the period of maximum thaw." Perhaps Dr. Trask's reactions were also reflected in the Director's concluding statement that "Dr. Trask was unable to predict what the extent, if any, would be of future tests in the Barrow area for his project with the Army Ordnance Group."

Lastly, and perhaps not so fortunately, when Robert Phillipe of the Army Corps of Engineers visited Point Barrow on October 30, Mathews was about to depart for a meeting at Elmendorf Air Force Base, and was able only to take him on a hurried tour of the installation. The records reveal that ONR had informed the Director of Mr. Phillipe's visit and had emphasized the importance of a proper showing with him because the Army Engineers were considering withdrawal of support from the permafrost project and were also considering a mapping project. Presumably, the outcome would depend considerably on Phillipe's report.

The fall of 1954 proved to be, in meteorological terms, a stormy one at Point Barrow. The first storm, mentioned in the Monthly Report for August, endangered the two boats being used by investigators at the time. Severe storms occurred on September 17 and 29, necessitating clearing the beaches of all boats. More seriously, stacked oil drums were scattered along the beach for a mile and a half as a result of beach erosion. "A crew of four men and equipment were busy continuously the

latter half of the month cleaning up the mess. This is the first time in the history of the camp at Point Barrow that such severe erosion has taken place."

Nevertheless, the September storms were apparently but a prelude to the one which arrived in October. According to the October report "The Laboratory outside crews were occupied the full month cleaning up after the storm of October 4; this storm was the worst ever experienced at Point Barrow in the memory of Eskimos. The beach profile was radically changed, cutting the bank away as much as 40 feet in places." Perhaps most serious was the fact that the sea water broke through into the freshwater lake used for water supply. The oil drums were further scattered over three miles of beach and many were lost. Eventually arrangements were made with the Air Force that ARL, on a reimbursable basis, would undertake whatever salvage operations were possible. The storms, Mathews reported, emphasized the vulnerability of the Barrow camp. He wrote "another foot of water would have caused severe damage".

On November 23 Mathews departed Point Barrow on his way to Washington where he participated in the meetings of December 6 and 7 which quickly changed the pattern of responsibility and operational control at the Point Barrow facilities, including the Research Laboratory.

The records reveal less than would be desirable for anyone attempting an objective assessment of the 1954 administration. Discussions of

the subject did occur at meetings of the ARL Subcommittee of the Arctic Institute's Research Committee, and at the November 28 informal meeting at Dr. Wiggin's home in Palo Alto. The summary reports of those discussions lack specificity, but conclusions were recorded. Clearly, despite the great understanding and sympathy for the difficult conditions under which the University and the Director had been operating, there was the feeling that the year had not been a good one for the research program and that changes needed to be made if the operation were to be continued seriously. The problem most mentioned was that of the need to have a scientist-administrator in charge as Director. Since the researchers---at least most of them---were scientists in one field or another, it was considered a handicap to morale and to effective operation of the Laboratory not to have a recognized scientist in charge. Beyond this, mention was made of "individuals who seem to be a bit difficult to get along with" and, as one person pointed out, "there were too many Indian Chiefs and too few Indians". It was mentioned also that the Director was gone a great deal of the time.

In summary, Dr. Wiggins concluded that the Laboratory staff must have done an exceptional job, and suggested that if indeed criticism existed, it should be withheld until the Laboratory has had a chance to 'shakedown' under its new administration.

THE ARL IN AN AIR FORCE CAMP

The question of who would succeed Ted Mathews as Director of the ARL was quickly answered when, by letter of December 13, 1954, President Ernest Patty of the University of Alaska offered the position to Dr. Hanna. The offer was made for half-year salary on the basis that the California Academy of Science would release Dr. Hanna for the six months at Barrow. The letter indicated that the offer was strongly supported by Dr. Quam and Dr. Wiggins.

President Patty did not hide his chagrin at the turn events had taken, indicating that the "new arrangement is, of course, disappointing to us. But it does mean that Dr. Quam, Ted Mathews, and ONR have salvaged all possible activities under pressure from high defense priorities in the Barrow area." He expressed his hopes for an eventual expanded arctic research program.

The offer of the directorship of ARL to Dr. Hanna was not without its ironical aspects, as reported to Dr. Quam by Dr. Wiggins in a letter of December 17, 1954. In his letter he discussed his belief that Dr. Miller, Director of the California Academy, would probably release Dr. Hanna for the ARL job, although he had pointed out to the members of the Academy Council that the Academy had submitted a proposal to operate the ARL, had been turned down in favor of the University of Alaska, and that "now the University of Alaska is asking the California Academy to bail it out of the pokey into which they have been thrown."

By letter of December 22, 1954 Dr. Hanna accepted the offer from Dr. Patty and indicated his intention to leave, with his wife, for Fairbanks in April. He would visit Washington and the east coast at the end of December in order to confer with officials of ONR and the Arctic Institute of North America.

The turn of events in early December 1954 had produced for the Navy, and especially for the Office of Naval Research, a new situation at Point Barrow. The take-over by the Air Force of most of the buildings and equipment at Point Barrow, and with this the undertaking to provide the support for ARL personnel and activities, was in some respects like returning to the pre-1954 days of Pet 4 and ARCON. On the one hand, ONR and the ARL were relieved of many administrative details, and on the other, the division of controls and responsibilities diversified and multiplied the types of problems to be faced.

The new Scientific Director did not arrive at Point Barrow until the 21st of April. In the meantime, questions had already arisen regarding the application of some of the Navy-Air Force arrangements. One of these concerned the disposition of some of the oil-well drilling equipment which remained at Point Barrow. This was transferred without exchange of funds to the Air Force in order to relieve the Navy of custodial problems. Questions also arose as to the custody of certain buildings. One of these was Building 13 at the Umiat base camp. With the approval of

the SDARL, ONR recommended that that building be retained under ARL control in the light of probable needs of investigating teams that would be operating in the area. Dr. Hanna wrote that he had the MacVicar, Usinger, and probably the Reed parties in mind. The projects are mentioned in the research part of this chapter.

Through James W. Dalton, General Superintendent at Barrow of Puget Sound and Drake (Western Electric sub-contractor), the proposal was made to DNPR in February that five additional buildings at Point Barrow be turned over by the Navy to Project 572 (DEW Line) use. With the exception of Building 353, this ultimately was agreed to.

By letter of March 25, 1955 from San Francisco, Dr. Hanna inquired of Dr. Quam, ONR, as to the LCM's that might be used to assist an Air Force project during the coming summer. This query opened the subject of control over LCM's which remained in the Barrow area. It was discovered that only one (the Goldie) actually had been transferred to ONR by the Bureau of Ships. Dr. Quam also found that the Bureau of Ships desired to have returned to Seattle all the LCM's at the end of the summer. Eventually BUSHIPS arranged that the ARL be permitted the use of the Goldie, the Ripley, and three others.

Comparable questions were raised during the spring of 1955 regarding other items of equipment, including LVT's and other items for which transfers of accountability were ultimately arranged in order to meet the needs of ARL.

One of the significant developments affecting ARL that occurred in ONR during the spring of 1955 was the negotiation which brought M. E. Britton to the staff to take over the arctic program. Dr. Quam visited Barrow in May-June and reported that Dr. Hanna had matters in hand. He returned to Fairbanks and Barrow in August in company with Captain Ragnar Thoren of the Royal Swedish Navy who had been associated with the work of Dr. H. W. Ahlmann, a noted Swedish glaciologist who was interested in the Juneau Ice-field. With him also was Dr. C. Warren Thornthwaite of the Laboratory of Climatology, Drexel Institute, who was interested in exploring the possibilities of field research in micro-climatology in northern Alaska. This eventually led to the initiation of a large-scale research project which began the next year.

At the end of September, Dr. Britton took an initiative which led to considerable activity. His proposal, conveyed to Dr. Hanna, Dr. Pitelka, Dr. Paul Hurd, and Dr. Wiggins was that there should be set up a "reference collection of tundra biota" at the ARL. In his letter to Dr. Pitelka he mentioned that "Perhaps plants, birds, mammals and insects will do for a starter." Dr. Britton requested early assistance in locating the various types of museum storage cases and other curatorial needs. He received favorable responses and practical suggestions from Dr. Hanna and the others and was encouraged to come to the aid of an ARL library also. Dr. Britton and Dr. Pitelka exchanged some

comradely arguments over the inclusion of comics in the library and the question of centralized versus decentralized storage of museum specimens.

As the summer of 1955 came to an end and Dr. Hanna returned to San Francisco to resume his work at the California Academy of Sciences, the question arose in acute form: Who would be SDARL for 1956? By letter dated September 27, 1955 Dr. Quam inquired of Dr. Robert Miller, Director of the Academy, whether he would release Dr. Hanna for one or preferably two years more. As a slight inducement, Dr. Quam offered the prospect of partial secretarial assistance for Dr. Hanna's necessary correspondence on ARL matters during the winter months.

The approach was unsuccessful. The California Academy decided it did not wish to release Dr. Hanna for two successive six-month tours at the ARL. That decision was said to be related to the Academy's desire to get a color-printing process established for the reproduction of scientific illustrations.

Hanna was in touch with Dr. Wiggins who found that he could be away from Stanford for six months during 1956 and was willing to return to the Laboratory for a second tour. Dr. Hanna suggested that perhaps he might be able to relieve Wiggins in 1957 if this should "be best for all concerned at that time". Later, in a letter of December 19, 1955 to Louis Quam, Hanna reported that he felt "sure now that I can get away provided that no other arrangements have been made" and that his services were needed for 1957 and 1958.

During the fall of 1955, however, ONR was giving serious consideration to the whole problem of the ARL directorship, and Drs. Quam and Britton were reaching certain conclusions which were spelled out in correspondence with Hanna, Patty, Brewer, and others. The considerations uppermost in ONR related to its desire for continuity under an able manager. This meant that it was unsatisfactory to go on juggling scientific directors as in the recent past. As was indicated in the correspondence also, the conclusion had been reached that the job at ARL was primarily one for an administrator or manager. As Dr. Britton wrote in a personal "feeler" to Max Brewer, it was his opinion that "the scientific aspects of the enterprise can best be handled in Washington since it is ONR's responsibility in the final analysis and we have AINA at hand as well as umpteen advisory boards" (letter of November 17, 1955). The growing ONR desire for a continuing administrator was related to the upcoming IGY, but was not dependent on it. A strong desire for full-time, rather than mere part-time, services also was emphasized. These considerations all added up to a reluctance to depend on the Wiggins-Hanna team to provide temporary leadership. The favored candidate for the "permanent" director was already being sounded out. Meanwhile, Dr. Wiggins had agreed to return to Point Barrow for a second tour as Scientific Director. His commitment was for six months beginning about April 1, 1956.

During the summer and fall of 1955 the subject of employing an assistant director to relieve the Scientific Director of managerial respon-

sibilities was brought up in the correspondence of President Patty and also by Dr. Hanna. Dr. Patty, in a letter of June 2, 1955 to Ed M. Little of the Naval Electronics Laboratory at San Diego, asked him to nominate such a man, possibly someone who would be interested in research on sea ice and would spend part time as assistant director. Dr. Hanna already had suggested to Dr. Patty the name of Norman Wilimovsky. In a letter to Dr. Quam as late as October 10, Dr. Hanna suggested that the appointment of an assistant director would have a bearing on his own return. He mentioned Marshall Schalk as a possibility. In the end no assistant director was appointed.

Under a cover letter of October 12, 1955 President Patty submitted a proposed ARL budget in connection with an extension of the University's contract. The proposal, which was submitted via the SDARL, was reviewed by Dr. Hanna, who found that the situation had been covered thoroughly. The budget which was to cover the period February 1, 1956 through January 31, 1957 showed estimated expenditures at \$123,000, net. At the same time an anticipated unexpended balance from the 1955 budget of \$93,000 resulted in a proposed addition of only \$30,000 in the extension as submitted.

The University of Alaska's proposal was reviewed in ONR, and by letter of November 2, Dr. Quam commented on the University's submission. He felt that the proposed budget was too conservative. He

suggested that the conditions which had led to the surplus of \$93,000 in the 1955 operating budget might change in the near future when the Air Force contractors completed their projects. He called attention to the badly depreciated capital equipment, such as weasels and jeeps, which raised the prospect of replacement needs. Quam also referred to the possibility of several projects under Department of Defense sponsorship at Point Barrow during the International Geophysical Year. He mentioned the possible need for an assistant director for the rush period of 1957-1958 and also referred to the possibility of purchasing a plane for the ARL, or at least having one on a stand-by basis for which the ARL would have first priority. In addition, Dr. Quam mentioned the increasing demand for an extension of research work into Umiat and the foothills of the Brooks Range, as well as at a number of points on the coastal plain. He mentioned the need for storage and housekeeping facilities at Umiat and perhaps also at Anaktuvuk Pass. Beyond this, there was the need for expanding laboratory facilities and services at the ARL, such as a working and scientifically useful library.

In the light of the above factors, Dr. Quam concluded, "It is our view that the apparent surplus should be retained by the University of Alaska. We are accordingly requesting our Contract Division to negotiate the renewal of your contract at the estimated annual rate of \$123,000.

Thus Dr. Patty's figure of \$30,000 was increased, in effect, by more than 400 percent. It was apparent that ONR's anticipations for the

ARL were far more ambitious than had been anticipated by the University and by Dr. Hanna.

A Modest But Successful Research Program in 1955

The ARL research program for 1955 began to take shape in the fall of 1954 with the submission of research projects and the screening of applications through the rather complex machinery of review set up within and outside ONR. On November 18, 1954, for example, the ARL Subcommittee of the Arctic Institute Research Committee met in Montreal and weighed the merits of 13 project applications that had been received by the Institute. Of these, 10 were given an "A" rating and 11 were recommended for support, two of them by the National Science Foundation, six by the ONR Geography Branch, and three by the Biology Branch. By the time the program had undergone full review and personal or other factors had been taken into account, the final program had been somewhat changed. Two highly rated programs fell by the wayside, while another project was picked up. Consequently, 10 of the AINA-considered projects actually were carried through. In addition, six projects supported directly by ONR or by other agencies also operated at the ARL during the year. By the end of his stay at the Laboratory, Dr. Hanna reported on October 1 that 16 research teams had used ARL facilities and 47 individual investigators, at some time during the year, had participated in those programs. Of the 16 projects, about half were essentially new. The biological sciences were

still heavily represented, but the earth sciences were being given more attention.

Among the continuing projects, the Arctic Ice and Permafrost investigations, directed by Max C. Brewer of the Geological Survey, was expanding its scope and continuing its data collection. Researchers assisting in that project in 1955 included Arthur Lachenbruch, Wayne Bruce, John and Joanne Merrick, Edward Remington, and Southard Modry.

The survey of beaches in the Barrow area, initiated by Marshall Schalk of Woods Hole in 1954, was extended by him, while measurements also were made of the changes that had been produced by the severe storms of the fall of 1954. In 1955 David Schalk and John W. Dow assisted investigations of on- and off-shore areas.

Gerald R. MacCarthy of the Geological Survey returned to Barrow in July, having continued his investigations into December the previous year. His research on the electrical properties of permafrost (conductivity) gave him the answers to some of the questions raised by his earlier work.

Max Britton, who formerly had conducted researches at the ARL under an ONR contract with Northwestern University, returned to Point Barrow for the week of June 12 to 19 to make some checks on instrument readings of previous years. In addition to that work on his own project, concerning the relationship of vegetation to physical environment, Dr. Britton also assisted other project leaders in setting up their related

researches in the micro-climatological field. His stay at the Laboratory was brief, but by the end of the summer he was installed at ONR in Washington, assisting the Geography Branch in directing the ARL program. There he began what was to become a long and productive career as director of arctic research for ONR.

As earlier mentioned, a group from Iowa State College spent some time at Barrow in 1954 doing preliminary work analyzing the engineering properties of arctic soils. Their concern related mainly to the compaction factors which would affect the construction of roadways and runways. In 1955 another Iowa State College group led by Keith Hussey, assisted by John B. O'Sullivan, carried out extensive exploration and took field samples of soils and clays for shipment to Iowa State for structural testing. A 20-gallon sample of heavy asphaltic oil from Fish Creek also was returned for tests as a possible soil binder. As an incidental product, the researchers also found numerous marine fossils. Mrs. Hanna assisted Dr. Hussey in preparing drawings and the fossil shells were sent to the California Academy of Sciences for identification.

During 1954 the Geophysical Institute of the University of Alaska had undertaken the operation of the Magnetic Station, including the photographic recording of the magnetic readings. That daily attention was continued in 1955, with Robert Leonard and M. J. Young in attendance. On August 1 Arthur Franzke arrived to relieve Mr. Leonard. In addition

to their magnetic work, the Geophysical Institute researchers also were taking time-lapse photographs of the aurora during the winter months. They also began assembling apparatus for study of the propagation of radio signals. Victor Hessler of the Institute spent the early part of September installing ground and other apparatus for the measurement of earth resistivity.

William L. Boyd of the University of Georgia had been at ARL during December-January of 1954-1955 beginning a study of bacteria which were readily available in nearby waters and soils. The results were so interesting to him that he returned on June 22 for the purpose of following the life cycle through a complete year. His 1955 project was temporarily set aside, however, when he was asked while enroute to test the suitability for domestic use of waters near various radar sites. This was approved by ONR, and Dr. Boyd became fully engaged on the water-testing activity through July and August. It was agreed that he would make occasional checks of the water at the Point Barrow camp which also involved ARL personnel. In September Dr. Boyd took up his study of micro-organisms under his project.

The investigations into the ecology of lemmings which Frank E. Pitelka of the Museum of Vertebrate Zoology of the University of California had carried on from 1951 through 1953, were resumed in 1955. Field activities in northern Alaska during the summer months concerned

particularly the life cycle of arctic lemmings. In the 1955 season Dr. Pitelka had three assistants, and the field activity could therefore be extended. For example, Richard Hansen worked at Umiat and made side trips to Kotzebue and other places through the courtesy of the 30th Batallion, U. S. Army Engineers, which occupied the Umiat camp and did extensive mapping. Henry Childs, another assistant, did field work near the Laboratory, but also operated in the Wainwright and Meade River areas. The third assistant, Brian McNab, worked mainly near the Laboratory.

In addition to the above continuing projects, a number were initiated in 1955 which were to return for two or more seasons. One of them was a project which was eventually to involve several researchers from the Department of Soils, Rutgers University. Dr. John C. F. Tedrow was the principal investigator and was himself at the ARL for three weeks during June and July 1955. His project was described as a "Pedologic Study of the Soil Forming Processes of the Arctic Coastal Plain". The 1955 field work involved the collection of more or less undisturbed soil samples. Dr. Tedrow and his assistant, James V. Drew, who remained for two months, found that the permafrost created a problem in the mechanics of soil sampling, and they tried various methods. Nevertheless, many samples were taken along the beach and a few miles inland. One trip was also made to Umiat to note the effect freezing and thawing had produced

on a number of cores that had been placed there a few years earlier by another project.

During July-August of 1955 the Scripps Institution of Oceanography at La Jolla, California, supported a field project to investigate the Barrow Sea valley and to install tide gages. The field group was led by Alan Beal, who was assisted by Robert J. Hurley and by COL Peter Ottosen (Ret.). Because the summer of 1955 had unusually severe sea-ice conditions, the Beal party was unable to attempt the oceanographic part of its program. Efforts, therefore, were concentrated on the installation of tide gages. That was done at Eluitkak Pass, and another gage was installed in a grounded LST at Barter Island. The installation at the Pass involved the sinking of a 3-1/2 inch aluminum tube to a depth of 15 feet and then filling the tube with kerosene. The float of the gage was suspended in the tube, and a recording instrument was installed in a housed-in weasel body to protect it from the weather. It already was known that the ocean tidal ranges in the area are very small, perhaps only 6 to 7 inches, but the water level varies much more than that.

The summer of 1955 also saw initiated an AINA supported project sponsored by Professors Richard Flint and John Rodgers of the Geology Department of Yale University. The project was entitled "Field Study and Mapping of Pleistocene and Bedrock Geology of the Chandler Lake Area". The leader of the field party was a graduate student, Donald C. MacVicar, Jr. He was accompanied to northern Alaska by two other

students, John W. Salisbury, Jr., and Charles M. Keeler. Dr. Flint visited the project in July. The three-man party was landed on Chandler Lake ice by DC 3 on June 1. Simon Paneak, an Eskimo from Anaktuvuk Pass, was hired as guide and assistant. The camp was resupplied on July 1 and August 1. Evidently, the party suffered some hardships during its 12-week stay, since Dr. Hanna took the trouble to include in his summary report on that party the observation that geologists must expect some discomforts and risks and that "they cannot always expect plush quarters, fancy food and constant communication with the outside world." He recommended a light balloon-cloth tent, each one equipped with a small "Nome green-willow" stove. (This sheet-iron stove burns the arctic green willow, uncured).

During the summer of 1955 a group from The Catholic University of America arrived at the ARL to expand studies which had been made elsewhere in Alaska. The project, one of the AINA subcontracts, involved a study of the environment and tissue chemistry of arctic blackfish. The field investigators were led by the Reverend Joseph B. Hanzely, assisted by three other priests, Rev. William D. Sullivan, Rev. John L. Ostdiek, and Rev. Edbert J. Long. They searched for blackfish at the Meade River coal mine area about 60 miles south of Point Barrow and in other streams and lakes closer to the ARL. Finally, a flight to an old reindeer camp, known as Half Moon Three Ranch, located between Admiralty Bay and

Teshkepuk Lake, resulted in a find of about 300 specimens of which half were brought back live to the ARL. About 100 of them were shipped by air to The Catholic University for further study, but the fish, when left unclaimed for 20 hours at the Washington Airport, perished. Further study of the environment of the blackfish was carried out by Father Ostdiek. Dr. Hanna reported that in his experience he had found that "the shipment of live aquatic material is always difficult".

Another ecological study with a small AINA grant was carried out by B. Elwood Montgomery of the Entomology Department of Purdue University. He reportedly had two interests: to find out if there are bumblebees on the arctic slope, and if so, if their habits follow the pattern found in a more temperate climate. During the three weeks Dr. Montgomery was at the ARL, he was able to collect 70 specimens of bees, including two complete nests found by other investigators. A third nest of 25 bees was found after he departed, and all were sent to him at Purdue.

A two-man research project under Edward B. Reed of the Department of Zoology, Colorado A. and M. College, spent two months in northern Alaska investigating the fauna in the lakes and ponds of the Colville and Canning river drainages. Insufficient time caused Mr. Reed and his companion, F. W. Jackson, to drop the Canning River part of the plan. Their project, nevertheless, was carried out effectively. They were landed with two rubber rafts by bush plane in the upper part of the Colville

River drainage near Liberator Lake. They had their necessary food and equipment with them and made their way downstream. After a stop at Umiat and a brief return to the ARL, they resumed their voyage down the Colville to the coast. From a radar site there they were brought back to the ARL by air. They had made a very large collection of their own, noted distributional patterns of fish in the river, and also collected many freshwater shells. These were, according to Dr. Hanna, the first of importance from the arctic slope and were sent to Dr. Hanna's California Academy of Sciences for study.

One of the projects initiated in the 1955 season was of special interest to the Director. He reported that during his 1954 stay in northern Alaska he heard vague reports of amber having been found on the arctic slope. Another researcher, Adair Fehlman, had reported finding a piece on Deadman Island the previous year. Dr. Hanna was also intrigued by the fact that there are two rivers on the arctic slope known as Oumalik, the Eskimo name for amber. Additional specimens had been turned up by members of a Geological Survey team and by Ted Mathews. One of these contained a fragment of a small insect. Dr. Hanna enlisted the cooperation of Robert L. Usinger of the University of California Agricultural Experiment Station, a recognized authority on insects contained in amber. The result was a field investigation completed in three weeks by Dr. Usinger and his associate, Ray E. Smith. Their searches along the Colville and Kuk rivers, and especially on the Ketik River, produced quantities of

amber. Some of the pieces contained beautifully preserved insects. The finds were determined to be Cretaceous and were in Dr. Hanna's words, "The oldest known so perfectly preserved".

Mention has been made that Max Britton, during his short stay at the ARL during June, had assisted other project leaders in getting started. One of those projects was that being initiated in 1955 by Royal E. Shanks from the University of Tennessee. He and his colleague, John J. Koranda, devoted nearly two months to investigations closely related to those in which Dr. Britton for some time had been engaged. The objective was primarily to determine facts regarding the growth of plants in an arctic environment. The stated project was to investigate the "Composition, Structure, and Productivity of Tundra Vegetation of Northern Alaska". There were many facets to be considered, preferably concurrently. Climate, soil conditions and temperatures, effects of grazing of animals, the work of humans, and many other factors were involved. Because all these could not be covered simultaneously, Dr. Shanks and Mr. Koranda concentrated on the nature of the vegetation cover in the vicinity of Point Barrow. Plants were collected and classified; selected areas were chosen to determine the number of individual plants of a particular species present; ground temperatures were continuously recorded in the area where Dr. Britton had carried out his studies, and "a framework was erected to support various kinds of equipment such as thermometers and anemometers

at different heights." Eventually some wire enclosures were set up in cooperation with the Pitelka project in order to determine later what plant cover would be produced in the absence of disturbance by rodents. It was realized by the researchers that a comprehensive plan of investigation would be required in order to produce the fundamental information needed. The Usinger project, therefore, became one more spur toward further planning for future investigative programs.

Looking ahead

At the meeting in Washington on September 12, 1955 of the Arctic Research Subcommittee of the Arctic Institute's Research Committee, Dr. Quam commented favorably on the 1955 research program. He stressed particularly the value of combined field trips and the close contact between the scientists of different basic sciences. In stimulating this thought of interrelationships, he said "the ARL is making an outstanding contribution in education and development. In general," he said, "the Laboratory is in good shape and Dr. Hanna has done an excellent job."

At this same meeting, attended by five representatives of ONR, there was further discussion of the need for evaluating procedures for developing ARL research projects. Dr. Quam said that he believed the stage had been reached where there was need to think more of the continuity of the program than in simply getting people to Barrow. As a means of greater consideration as to how specific proposals would fit into the total program,

he suggested consideration of revising the planning machinery. He had given some thought, he said, to a reorganization of the ARL Committee to include scientists who had conducted operations at Barrow, or to set up such a group as Advisors, to review proposals to assure feasibility, avoid duplication, and to suggest the line of endeavor. He suggested that, for example, Dr. Wiggins should pass upon all proposals in the field of botany. Others were suggested for other disciplines. The minutes of the meeting record that objection was voiced by some of those present as to the possibility of one scientist dominating his field. Evidently no formal action was taken on Dr. Quam's suggestion. He reported, however, that he had invited C. Warren Thornthwaite of the Laboratory of Climatology, Drexel Institute, to give his views on investigations in microclimatology, a field in which some work already had been done by Dr. Britton and Dr. Shanks.

Dr. S. R. Galler, representing the Biology Branch of ONR, asserted that the interest of his division in ARL was much more restricted than that of the Geography Branch. "At this time", he said, "the Biology Branch's interests are in hydro-biological research (marine and limnology), and it has secondary interest only in encouraging young people to become acquainted with the Arctic." He referred again to his desire to have competent senior scientists at the ARL. This comment revived a previous point of contention regarding senior versus junior scientists at Point Barrow. Dr. Galler, on this occasion, voiced his conclusion that there should be fewer and more expensive projects where the principal investigator is

completely supported by a premium stipend, rather than to have many small projects. This suggestion was not picked up. John Field mentioned the desirability of stimulating international interest. No further comment on this suggestion was recorded in the minutes.

At the next meeting of the ARL Subcommittee of the AINA Research Committee, held on November 7, 1955, the research proposals for 1956 were reviewed and evaluated. Dr. Quam again discussed the aims and scope of the whole program. After reporting that ONR funds for the ARL had been halved, he noted a surplus of operational funds in relation to research funds. He described the 1955 research program as having fallen into three general areas. One, pertaining to the study of land environments, was centered around the work of Pitelka in animal ecology, Shanks' project in plant ecology and microclimatics, and Tedrow's effort in soils. Geology and permafrost studies contributed to those. The second area was in geomagnetism and the characteristics of the upper atmosphere. That work centered in the researches of Dr. Elvey, and pointed clearly to the need for more research in arctic meteorology. The third area, in oceanography and hydrobiology, was represented and had a pressing need for more research. Dr. Quam again rejected excessive emphasis on specific objectives, but suggested that the three areas could be used as a base for long-term planning. There was general support at the Subcommittee meeting for Dr. Quam's proposals. Dr. Reed said, for example,

that they "constituted a natural development in the overall history of the Laboratory's development".

At the November 7 meeting there was also some discussion of the view advanced by the Chairman, Hugh M. Raup, that a determined effort should be made to keep resources from getting too heavily committed to continuing projects, "so that there would always be a flow of 'new blood' into the program." The Minutes report that there was general agreement that this was desirable, but it was also noted that there was a strong tendency to give continuing support to a "going" project under a good leader.

Also discussed at the November 7 meeting was a proposal by Dr. Reed that ARL operations should be extended to cover a somewhat larger geographic area. Specifically, it was suggested that the expansion should include Barter Island and Bettles, thus greatly enlarging the variety of natural conditions available to research workers. The suggested additional area would involve roughly a triangle of land with the center at Umiat, with distances between airstrips such as to be covered easily by light airplanes. Dr. Reed's proposal was strongly supported by other Committee members, including the ONR representatives, Dr. Quam and Dr. Britton. It was voted to go ahead with the plan, subject to approval of the University of Alaska which was responsible for the operation of the Laboratory.

The remainder of the November meeting was devoted to consideration of the 24 research proposals for 1956 that had been received. A particularly thorny problem was presented by the proposal that had been submitted by

C. W. Thornthwaite (Climatology). It was agreed that there was no question of the desirability of research of the type proposed, and evidently there was no question of the proposer's qualifications. He had been invited to submit a proposal. However, his proposed budget for the first year was \$25,000. The probable total of ONR 1956 research funds for distribution by AINA was about \$55,000. Dr. Quam and Dr. Britton were, therefore, invited to try their hands at getting agreement on a revised budget.

As a follow-up to the November 7 Subcommittee discussions, its Chairman, Hugh Raup, reported to Dr. Quam by letter of December 2, 1955 the substance and outcome of discussions of the full AINA Research Committee and the AINA Board of Governors on November 17 and 19.

The Arctic Institute, Dr. Raup wrote, agreed that some additions to the advisory subcommittee probably were desirable, and specific names would be discussed informally with ONR. He also invited nominations from Dr. Quam. He added a final sentence to this paragraph "I would point out, however, that the Institute currently believes that the program at the Arctic Research Laboratory is improved tremendously over the program of a few years ago and is now reasonably well-balanced."

Respecting Dr. Quam's proposal to emphasize the three fields of research (land environment, geomagnetism and upper atmosphere, plus oceanography and hydrobiology) Dr. Raup indicated that the Committee "fully endorses your position that those three fields are worthy of special

attention and emphasis." He continued, "The Committee further thinks, with you, that the focusing of effort in those areas may well result in an even better program than that which has been going on". By way of keeping the door partly open to projects not falling specifically within the three areas, Dr. Raup reported the Committee's understanding that exceptional projects in other areas would not be excluded and that the Laboratory would make every effort to accommodate researchers in other fields, provided the support for them came from outside ONR. The Committee had noted, with regret, that the field of anthropology, including archaeology, was not specifically set forth as a field for special endeavor.

"The committee", Dr. Raup wrote, "endorsed the advisability of broadening the specific geographic area of interest of the Arctic Research Laboratory to include Bettles, Barter Island and Umiat."

Finally, Dr. Raup reported that the Committee had ten projects for recommendation to ONR. The Thornthwaite proposal, the Committee felt, was especially expensive, the major part being due to high salary rates. Earlier, he wrote, the Institute policy had been against paying salaries; more recently "salaries had been provided on the basis of academic pay."

DR. WIGGINS SERVES A SECOND TIME

AS SCIENTIFIC DIRECTOR

When Dr. Wiggins was "drafted" a second time to become Scientific Director of ARL, it already was virtually decided in ONR that he would fill

in until a more permanent arrangement could be made with Max Brewer to take over the administration of the Laboratory.

On his way to Point Barrow in March Dr. Wiggins stopped off in Fairbanks where he was met with a problem, presumably based on a report received by the Air Force (COL Harvey E. Rohrer, Alaskan Command) that plans were being made for some 200 scientists to be at the ARL during the summer. Because Wiggins knew of the 60-man summer ceiling, this did not worry him, but it became apparent that the Air Force, for counting purposes, would wish to count a 25-man team as part of the ARL contingent. Dr. Quam, by letter of April 13, 1956, clarified the situation by stating that the ONR never had agreed to support more than 15 men in an Air Force group.

On May 3 Max Brewer formally accepted an appointment as Director, Arctic Research Laboratory (DARL). The acceptance was to Dr. Patty, President of the University of Alaska, which held the ARL operating contract. The appointment publicly was announced by the University on June 5.

On July 6, 1956 Dr. Wiggins sent to Dr. Britton in ONR a memorandum he had received from the Western Electric Company (which was in charge of the DEW line operation) outlining in detail the terms under which the local Air Force representative proposed to return the Point Barrow facility to the Navy by January 1957. Dr. Quam's response, by

letter of July 16, informed Dr. Wiggins that the plans were premature, and that the Air Force contractor activities were not scheduled to terminate until April 1957. Accordingly, he suggested that the ARL continue existing support arrangements with Puget Sound and Drake until that time. Dr. Quam wrote, "It appears that we will be able to work out arrangements with Air Force for continued support of ARL." Dr. Wiggins replied that the information received was "very welcome", and that the necessary arrangements would be easier to make if the existing support was not abruptly chopped off at the end of the calendar year.

The Air Force relationship did not cease to be a matter of concern, however, and Dr. Wiggins continued to be troubled about the number of Air Force personnel at Point Barrow. Shortly before he left the ARL on September 8 he wrote to Max Britton that the Air Force team at Barrow now had 26 men, and he had information that they planned to increase it to nearly 100 men. On the same date he also wrote about his desire that the Air Force return the machine shop to the Navy when the existing contract phased out, because it would be important for Dr. Hanna's planned project of carrying out a rebuilding job on the weasels during the IGY period. Dr. Wiggins proposed early planning to provide for the return of the shop to the Navy for ARL use.

Dr. Britton made an extended six-week trip to Alaska during the July-August period, and was at the ARL when twin disasters occurred in

July. His reports to Dr. Quam in ONR expressed general satisfaction with the progress being made on research projects, but also found "an awful lot of petty stuff floating around". He contrasted this with the "relaxed atmosphere last summer under the guidance of Doc Hanna". Before Dr. Wiggins left Point Barrow in September, Dr. Hanna had agreed to return for a year, beginning in October 1956, largely for the purpose of applying his known talents to the rebuilding of a considerably run-down fleet of weasels and other transportation equipment.

During January and February 1956 the staff at ARL was busy taking inventory of stocks on hand, including particularly the transportation equipment, particularly weasels and spare parts for them. Weasels and jeeps used by the ARL were all painted a beautiful olive drab by Chester Lampe. In February red paint arrived, to be used this time for painting the floors of the Laboratory buildings.

During the winter months there were few researchers at the camp, and most of the research activity carried on by Dr. Boyd, Max Brewer, and Robert Franzke involved readings of established instruments. Dr. Rausch, Chief of the Zoonotic Disease Section of the Arctic Health Research Center in Anchorage, spent some days visiting Barrow Village, Wainwright, and Point Lay in search of fox, fish, and lemming specimens in order to continue studies of diseases communicable from animals to man. He was assisted in local transportation by the Western Electric Company, through its local representative, C. S. Lawson.

Dr. Wiggins arrived at the ARL on March 29 and assumed charge for the second time. His arrival had been preceded by a visit by J. Wallace Joyce, head of the Office for the International Geophysical Year in the National Science Foundation, who was interested in preparing for the IGY program to be carried on in the Arctic the next year. Staff changes at ARL, in addition to the new Director, included Frank Talbert, who was brought back to Point Barrow to be shop foreman, and Gilbert Fredrickson, to be storekeeper.

April and May were busy months, with the basic negotiations and local arrangements necessary to prepare for the summer research program. Negotiations were started and completed for the purchase of a Muskeg Tractor to be tested for "performance and versatility", with a view to the time when weasels would be unobtainable or exorbitantly expensive. Specimen cases built in the California Academy of Sciences under Doctor Hanna's supervision arrived at the end of May and were used for the storage of insects and herbarium materials. Cases for storage of mineral and fossil materials arrived late in the summer. Thanks to Dr. Hanna's foresight, the Laboratory received also a large quantity of surplus items, including cameras, transits, chemicals, tools, rope, parkas, and other needed equipment.

In July twin disasters hit the ARL. A party of four researchers returning from the Sagavanirktok River stopped overnight at the camp at

Umiat. The party included Royal Shanks, Keith M. Hussey, James Drew, and John Koranda. On the morning of July 15, while the four had gone across to another building to prepare their breakfast, the building in which they were staying caught fire. Because of the high wind the flames quickly enveloped the whole building, and it became a total loss. The loss included all the equipment, specimens, and notes of the four researchers, as well as all personal gear and clothing except what the men were wearing. The cause of the fire was not definitely established, but was attributed to a faulty stove. To add additional woe to the party, it was found that the lost equipment was not covered by insurance.

Less than a week after the disastrous fire at the camp at Umiat, a second and far more serious blow struck the Laboratory. That time not property, but the loss of life was involved.

The party affected was the Yale University group of which Donald G. MacVicar was the chief investigator. Three of the party, MacVicar, Mike Holdaway, and Pat Wilde, were camped on the east shore of Chandler Lake while carrying on their geological investigations. A fourth member, John Campbell, was off by himself in the Anaktuvuk Pass area on his own archaeological researches. The disaster occurred suddenly on the evening of July 20. Don MacVicar and Mike Holdaway were returning to their camp from a day's work on the west side of the lake. They were crossing the lake in a small canvas boat when a sudden squall came up. Before the

occupants were able to row to shore, the boat was swamped and the two men were in the water. Mike Holdaway finally managed to reach shore not far from the camp, but Don MacVicar was lost and obviously drowned.

The July 20 tragedy remained unknown to the ARL administration at Point Barrow until the evening of the next day. A Geological Survey helicopter had landed after seeing the improvised SOS signal on the ground which had been put out by Holdaway and Wilde. A message was then relayed by radio through the Wien Alaska Airlines system from Umiat. After dispatching a wire to Don MacVicar's parents and to his major professor at Yale (Dr. Flint), Dr. Wiggins immediately made plans to proceed to the scene of the accident. By radio inquiry he learned that the body had not been recovered, and that MacVicar's companions did not wish to leave the scene until a search for it had been conducted. Due to a heavy fog, Dr. Wiggins was unable to reach the Chandler Lake camp until the evening of the 22nd. He already had requested aid from the Air-Sea Rescue Unit at Ladd Air Force Base.

An intensive search immediately was instituted at Chandler Lake to recover MacVicar's body. On July 24 a bush pilot, James Anderson, brought John Campbell back from Anaktuvuk Pass. The University of Alaska was asked to help with smaller grappling hooks and with additional food supplies. The rescue planes were ordered to leave for other duties on the evening of the 24th, but the search for the body was continued

through the aid of six members of the Tanana Valley Rescue and Emergency Unit. Two researchers from the ARL were also at the scene, aiding in the search (James Drew and Lowell Douglas). Dragging operations were continued until July 30, when the Rescue Unit had to leave. After a stop at Fairbanks to arrange necessary details with the District Attorney, Dr. Wiggins returned to the ARL, arriving there on August 1.

On August 6 the Scientific Director returned to Chandler Lake, after having arranged with the Navy Underwater Demolition Unit to undertake further search for the body by diving operations. Those efforts also proved to be unsuccessful. Deteriorating weather and other demands on the Demolition Unit forced the abandonment of the search. Don MacVicar's body never was found.

Dr. Wiggins terminated the search with great reluctance and returned to Point Barrow. He then prepared an extensive report of the whole series of events, to which were appended the personal depositions of John Campbell, Michael Holdaway, and Pat Wilde, the remaining members of the party. He also appended a list of all who had assisted in the search efforts and copies of all the messages sent and received in connection with the accident. This 25-page report contained many details regarding the events surrounding the accident itself, the efforts to recover the body, and the handling of a number of details regarding the personal effects that were left by MacVicar. The unsuccessful attempts

to recover the body were a severe disappointment to Dr. Wiggins, who had exhausted himself in organizing the effort.

In a letter to Dr. Hanna dated August 31, 1956, Dr. Britton, who had been at the ARL at the time of the accident, summarized his view that "Doc Wiggins did an exceptionally fine job of handling the entire MacVicar incident." The grieving parents of MacVicar also expressed their thanks for the spirit and effort as well as the sympathy Dr. Wiggins had shown.

The month of August was another busy one in transporting and supplying the field parties of researchers, many of whom were operating in the Umiat, Meade River, and Wainwright areas. Repairs had to be made to the Ripley, one of the three ARL off-shore boats. Neither the Ivik nor the Confucius was used. The annual ship-lift arrived in August, carrying much surplus equipment which was highly appreciated. Not equally appreciated were four boxes of equipment and supplies essential for the proper conduct of one project. The equipment should have reached Barrow in mid-June instead of mid-August. The team's summer program had to be revamped to permit operations without the missing equipment.

Max Brewer, the new Director-to-be of the ARL, arrived on August 23. Because he had previously spent much time at the ARL in charge of the Geological Survey's Arctic Ice and Permafrost project, he was no stranger to the Laboratory's operation.

W. B. Girkin of ONR arrived on August 30 to continue property arrangements and to carry on discussions with the Contractor's offices. Discussions concerned the anticipated return of property loaned to the contractor companies by the ARL when the Air Force Project 572 (DEW Line) was activated. Mr. Girkin also checked and inspected the physical property of the ARL as well as the inventory and stock lists.

Dr. and Mrs. Wiggins departed ARL on September 30. Together with the new Director they stopped at Juneau for five days to attend the Seventh Alaskan Science Conference. Dr. Wiggins expressed disappointment that so few papers were presented by ARL investigators; those by Hessler, Lachenbruch, and Brew being the total ARL representation.

A year of solid research accomplishment

As has already been mentioned, the research program for 1956 was taking shape during the final months of 1955. By the end of the year the Arctic Institute had recommended 10 projects for support. Eight of them eventually were carried out, and two more were added. The program assembled was, as before, a combination of projects continuing from the year before, plus a number of new projects. In overall dimensions the 1956 program did not differ greatly from that of the previous year. Nineteen research projects were pursued. A total of 48 researchers participated for periods of varying length. These figures compare with the 47 researchers on 16 projects the year before.

No special problems of unusual character arose during the first half of the year. The return of Dr. Wiggins as Scientific Director assured a practiced hand at the local controls. It was not until July that the heavy hand of misfortune descended on the Laboratory. Despite this, the year was a productive one for nearly all of the projects undertaken, and new ground was broken in the direction of coordinated field research.

The 1956 research program

The greater part of the 1956 research program consisted of continuations of projects initiated in 1955 or earlier. In some cases the composition of the field teams was changed, and in one case there was a change of the principal investigator.

In the biological field the Boyd, Montgomery, and Pitelka investigations were continued. In addition, a new project, under an AINA subcontract with Ingrith J. Deyrup of Barnard College was begun on the "Metabolism of Arctic Rodents". Also, during the summer of 1956 William J. Maher of the University of California, and formally attached to the Pitelka group, made field investigations of the population ecology of the pomarine jaeger. That study, of course, was directly pertinent to the lemming ecology investigations, because the jaeger is a predator on lemmings.

In the earth sciences the Max Brewer ice and permafrost project continued, as did Keith Hussey's study of arctic soils, MacVicar's

geological researches at Chandler Lake, Marshall Schalk's beach and shoreline studies, and John Tedrow's soil studies. Related to some of these, a new project, the micrometeorological studies of C. W. Thornthwaite was initiated. The amber investigations begun by Robert Usinger in 1955 were carried on in 1956 by Ralph Langenheim, also of the University of California. The Pennsylvania State University initiated a field study of arctic coals, with Russell Dutcher and Charles Trotter as the field investigators. Also during the summer the Navy Electronics Laboratory sent J. F. Theodor Saur and Rexford Rowray to install and operate equipment for the measurement of thermal radiation exchange as part of an investigation of the heat budget of the Alaskan coastal areas.

Investigations in 1956 which related more particularly to marine subjects included the continued sea-valley and tide-gage studies by M. Alan Beal and John Sherman III, Navy hydrographic studies carried on by Dan W. Olds and Ed H. Lessman of the Navy Hydrographic Office, and a brief study of sea ice by Geza Teleki for the U. S. Army.

During 1956, also, the Geophysical Institute of the University of Alaska continued its magnetic and radiation studies, including the operation of the magnetic observatory. Arthur Franzke and Glenn Stanley were the senior field investigators for the Institute.

Of the 19 research programs operating in 1956 only three were operating on a year-round basis. They were the ice and permafrost

project (Brewer), the Barrow magnetic observatory and auroral recording operations (Franzke), and the taxonomic and ecological survey of micro-organisms (Boyd). The tide-gage installations at Point Barrow and on the LST at Barter Island were inspected in March. At neither installation was the gage in working order. At Barrow an ice plug had frozen in the bottom of the float well; at Barter Island the shelter housing the recorder had been moved, and the recorder had stopped the previous September.

One of the innovations in the 1956 research program was a grant to Miss Ingrith Deyrup from Barnard College. Previously the resident women researchers had been wives accompanying their researcher husbands. All reports from the ARL indicated that the new departure was successfully coped with, both by the ARL management and by Miss Deyrup to the satisfaction of all concerned. Major credit for this was accorded to Miss Deyrup.

The summer of 1956 introduced to the ARL one of the more ambitious research projects up to that time. The project involved micrometeorological studies and was directed by Dr. C. W. Thornthwaite, Director of the Laboratory of Climatology of the Drexel Institute. Dr. Thornthwaite had visited Point Barrow the previous summer and had conferred extensively with Dr. Britton and with others who were interested in the project and who were impressed by Dr. Thornthwaite's qualifications. His field assistants in 1956 included William H. Shellabear, William Superior, John R. Mather, Stanton J. Ware, and Henry Hacia.

Other new researchers at Point Barrow in 1956 included Russell Dutcher and Charles Trotter from The Pennsylvania State University, Ralph Langenheim from the University of California and his assistant, Charles Smiley from Macalester College. Royal Shanks brought Edward E. C. Clebsch from the University of Tennessee to participate in his work on tundra vegetation. Lowell A. Douglas from Rutgers University joined the Tedrow soil-investigation team.

On the whole 1956 was a year of solid accomplishment for several of the projects. In other cases a small beginning or a small increment could be recorded.

Alan Beal's tide-gage work for the Scripps Institution faced the discouraging fact that the 1955 installations had not continued to record. The 1956 season was, therefore, devoted to overcoming the problems that had earlier caused failure. Part of the response was the installation of a heating device which would make possible continuous winter recording. In this there was apparent success. John Sherman III, who remained at Barrow through the fall months, reported continued functioning through December.

Brewer's permafrost project continued on a 12-month basis, which provided for a regular schedule of geothermal measurements at Barrow, Fairbanks, and Glenallen. The installation near Glenallen was established in order to provide an estimate of the rate of decay of permafrost beneath

roads. A report on The Effect of the Ocean on Permafrost Temperatures was completed and revised by the end of December.

During their relatively brief stay in northern Alaska from July 24 to August 11, Dutcher and Trotter were able to visit the Meade River coal mine and to secure samples of the coal and shale strata they were interested in. The samples were shipped to Penn State for analysis. A proposed trip up the Colville River from Umiat was prevented by the high river level caused by heavy rains in the northern Brooks Range.

The investigation of amber deposits which Dr. Usinger had initiated in 1955 was picked up in 1956 by Dr. Langenheim. He and Smiley were flown to the Kaolak River area on July 11 and remained in the field for 35 days. Their searches on the Kuk, Avalik and Ketvik rivers produced plant fossil collections, amber collections, plus coal and rock samples. Dr. Langenheim concurred in the conclusion reached a year earlier by Dr. Usinger that the amber was Cretaceous. The investigator concluded that the chief contribution from the project would "be in systematic paleobotany with a lesser contribution in descriptive geology and stratigraphy".

Frank Pitelka continued his research on Ecology of Lemmings through extensive field work and observations from May to September. Surveys were made near Barrow and also on trips to the Inaru River, to Wainwright on the Meade River, and to Umiat. Observations were made

of population density; reproductive rate and trends; vegetation utilization; and predator populations, including the snowy owl, pomarine jaeger, and weasel. Dr. Pitelka was assisted by Tom J. Cade, Michael Marsh, Richard D. Taber, and William J. Maher. The latter made special studies of the ecology of the pomarine jaeger to provide further information on lemming predators. The whole project was meant to be continued in 1957.

Dr. B. E. Montgomery of Purdue University returned to the ARL for a month's stay during July-August in order to gather further information on the ecology of bumblebees of the arctic slope. Many specimens were obtained, partly through the aid of other investigators, in the Barrow vicinity and along the Meade and Inaru Rivers. Study also was made of the role of the arctic bumblebee in pollinating native flowers.

Dr. William L. Boyd continued his around-the-year researches and tests on microorganisms. He was joined by his wife in the fall. The research involved repetitious bacteriological testing of soil samples, fresh-water samples, and on occasion, ice samples and salt-water samples. Intestinal bacteria in lemmings were isolated and classified, food-spoilage rates were noted, air contamination was analyzed, and chemical analyses of run-off water were made. In November Dr. Boyd was called upon to identify the toxin which contaminated food (custard) which was responsible for transmitting food poisoning to approximately a third of the personnel in the camp. Dr. Boyd also was able to assist the Western Electric Company in tests of drinking water at DEW Line stations.

At the end of two months Miss Deyrup left the ARL, having reported a satisfactory series of experiments, 31 in all, on lemmings, ground squirrels, and one preliminary study on an infant hair seal. Her study of water and metabolism of tissues of rodents involved "experiments covering a wider range of incubation conditions (varied with respect to temperature, pH, Substrate, etc.) which would be of value in describing more completely characteristic shifts of water and electrolytes in vitro in the tissues of arctic adapted animals". She reported that the ground-squirrel tissues showed water shifts generally similar to those of lemming tissues.

Marshall Schalk's three-man team from Woods Hole Oceanographic Institution arrived at the end of June and continued to sound off-shore beach profiles in the Barrow region for more than two months. In addition to running their own profiles the Schalk team also was of assistance to other investigators such as Alan Beals' tide installations, Dan Old's hydro work, Robert Franzke's electrode placements, as well as other projects, including those of Saur, Tedrow, and Boyd.

Two representatives of the Navy Hydrographic Office were stationed at the ARL for two months, July to September, to monitor the four automatic weather stations in the polar ice pack north of Alaska in support of the sea-ice forecasting program. Dan W. Olds was succeeded by Edward H. Lessman in early September. Monitoring stations were installed at Point Barrow and two points on the northern Alaskan coast. The team

also installed and monitored radio direction-finding equipment for determining ice drift.

The Navy Electronics Laboratory team of J. F. T. Saur and Rex Rowray arrived at the ARL on July 28 to set up thermal radiation-recording equipment. This was largely accomplished in August. In addition to the installations on the tundra, bathythermograph sections also were made off-shore and changes in water temperatures were noted. After Saur departed on October 11, readings and observations continued to be taken by John Sherman III, of the Scripps Institution of Oceanography.

The 1956 season, therefore, saw the beginning of the heat-budget investigations which Saur had outlined in the following terms in a letter to Dr. Hanna of February 8, 1956. "Our purpose is to try to evaluate the heat budget of the Alaskan coastal waters in an attempt to see if it or parts thereof, can be related to ice conditions in the region. A major part of this is the assessment of net radiation between incoming solar radiation and outgoing terrestrial radiation. Our first objective is thus to install this summer the necessary pyrreheliometers and flat plate radiometers to record or evaluate (1) incoming solar radiation, (2) reflected solar radiation, (3) outgoing long-wave terrestrial radiation, and (4) incoming long-wave atmospheric radiation."

The summer of 1956 was a very productive one for Royal Shanks' investigations of the composition, structure, and productivity of tundra

vegetation. The three members of the group, Shanks, Clebsch, and Koranda, ranged over many areas of the tundra, especially along several of the rivers, and collected a great many plants, including lichens. Soil fertility studies also were made and, through cooperative activities with other investigators, such as the Tedrow and Thornthwaite parties, soil, vegetation, and climatic information was assembled; much of it to be studied later.

John C. F. Tedrow and his assistants, James V. Drew and Lowell A. Douglas, arrived at Point Barrow in mid-June to continue their project of investigating the soils of the arctic slope of Alaska. Soil mapping, which had been initiated in 1955, was extended southward. This included delineation of the major soil units, their relative wetness, and the types of polygons present. James Drew joined the group which surveyed the Sagavanirktok River and made a reconnaissance soil survey of the area. Samples of tundra profiles were collected for detailed analysis, to be done at Rutgers University. The Tedrow project, like that of Shanks, was related to the work of the Hussey and Thornthwaite groups. Drew and Douglas also relied on information developed by the MacVicar party in the Chandler Lake area. Part of the summer's work of the Tedrow party involved studies of the decomposition of organic matter in arctic soils, done by local experimentation with different soil types.

Keith M. Hussey from Iowa State College returned to Alaska for nearly a month in June-July 1956 to continue his investigations of the

Pleistocene geology of the area. After collecting materials from "shot holes" in drained-lake areas in order to determine fossil content, Hussey joined Shanks, Drew, and Koranda on an investigative trip on the Sagavanirktok River. With the other members of the party Hussey suffered the loss of his equipment and collections in the disastrous July 14 fire at Umiat, where the returning party had stopped overnight. John B. O'Sullivan, who assisted Hussey in his investigations, did not accompany him on the river trip.

A research project of wide scope and interest was initiated in the summer of 1956 under the direction of C. W. Thornthwaite. Thornthwaite himself spent some time at Point Barrow during July, but at other times the local field investigation was carried on by assistants. The project involved micrometeorological studies of the land areas in the Point Barrow region, to be carried out by the use of sophisticated technical and scientific equipment. During the summer of 1956 such equipment was installed at or near the Laboratory, and observations were begun. Data were obtained on temperatures, wind velocities, dewpoint, and other relevant aspects. The degree of refinement of data sought may be deduced from the fact that the thermocouples recorded temperatures at 17 levels between the permafrost and 120 centimeters above ground. After the departure of Shellabear in September, the air- and soil-temperature observations were continued on into the fall and winter by Schalk.

The Yale University project on the Geology of the Chandler Lake region under Dr. John Rodgers, with Donald G. MacVicar as the principal

field investigator, resumed its activities at the end of May, with the arrival of MacVicar, John Campbell, Mike Holdaway and Pat Wilde. The field investigations conducted during June were enthusiastically reported at the end of the month, and when Rodgers visited the camp in early July he reported excellent progress in the geological mapping. Operations were somewhat hampered by snow, which piled up three-foot drifts, but most of the time, the weather was favorable. Campbell, whose investigative interest was to carry out archaeological investigations in limestone caves in the area, was an anthropology graduate student interested in early Eskimo culture. From notes on the flora of the region which MacVicar had compiled, Dr. Wiggins was able later to publish a joint paper on the results of MacVicar's observations which had been made as incidental to his geology project.

The Geophysical Institute of the University of Alaska continued throughout 1956 the operation of the Magnetic Observatory and during the darker months, also the operation of the automatic auroral camera. A new camera was installed at a new site in November. Robert Franzke continued in residence at the ARL and was assisted in later months by Frankie Lampe.

The Geophysical Institute also carried on an investigation of earth potential (electrical resistance) during the year under the supervision of Victor Hessler, who visited the ARL in June and December in order to

supervise electrode installations and recording equipment. Constant readings were taken by Franzke.

During July, the ARL (Franzke) was a participant in a one-month operation called Project North Pole. This was a test of radio propagation between Norway and Alaska across the North Pole. The test was also assisted by the 6981st Radio Group, Air Force, which had personnel stationed at Point Barrow. During a few days in August and again in September, the ARL also supplied logistical support for two men from the Geophysical Institute, Glenn Stanley and Norman Sanders, who were conducting special investigations by aircraft.

Summary of 1956 research

In his last communication from Point Barrow before he departed for Stanford, Dr. Wiggins on September 9, 1956 summarized his view on the season's research program. He wrote to Dr. Britton, "I can say right now that I think that the work of the summer has been good, that the teams have been of high caliber, and that there has been a minimum of 'boondoggling'. The lateness of the ice-free season hampered several, among them Schalk, Saur, and Beal. The fire at Umiat was a serious loss of records, but the groups involved managed to salvage a good deal by writing down all they could remember within a few days of the accident."

From correspondence between the SDARL and ONR at the end of the summer, it is clear that most of the projects had been worthwhile and had

been capably handled. One of the dividends of the 1956 season was a collection of the varied flora of the Schrader Lake area brought in by Max Britton of ONR in July. The specimens were valuable additions to the materials Dr. Britton had collected on his previous investigations on ARL projects.

M. C. Brewer became Director of the ARL in September, 1956. This was a significant milepost in the development of the Arctic Research Laboratory, although the significance was, at the time, noted mainly in terms of local administration, rather than in terms of changes in the research programs and goals.

The ARL Subcommittee of the Research Committee of the Arctic Institute met in Washington on November 23, 1956 to consider the 1957 research program. Aside from the discussion and evaluation of project applications, some attention was given to broader subjects. Most of this concerned the role of the Subcommittee and of the Arctic Institute. The difficulties of launching and continuing a well-balanced program were noted, but it was the concensus that substantial progress had been made during the last few years.

Dr. Louis Quam, ONR, pointed to the need for closer liaison between members of the Subcommittee and those active in their respective fields who might become interested in research at ARL. He stressed the desirability of such enlarged contacts and asked for a determined effort to make them.

In discussions of the research program it was generally agreed that the program needed intensification in oceanography, meteorology, and the study of sea ice. It was felt that the existing program of land research "is reasonably adequate and promises to produce notable results".

A NEW ERA BEGINS

Plans had been started early in the spring of 1956 looking toward the termination of Dr. Wiggins' tour as Scientific Director some time in the fall. A letter dated March 30 from Dr. Britton to Dr. Wiggins indicated that President Ernest Patty of the University of Alaska even then was attempting to make a contractual arrangement for Max C. Brewer to become the next Director. The arrangements were concluded satisfactorily, and Brewer joined the ARL staff as of September 1. Thus he and Dr. Wiggins overlapped at the Laboratory from August 23 until late in September when they both left to attend the Seventh Alaska Science Conference in Juneau, which they did from September 26 through 30. A new era began as Brewer became the DARL. He has remained in the position continuously since then, and the ARL has grown in size, service, and prestige under his leadership. He assumed the directorship as a relatively young man, and he has made the ARL and the Arctic a career for more than a decade. His name is known and respected in polar circles around the world. His list of friends and acquaintances includes innumerable military men, Eskimos, administrators, scientists, educators, and a host of others.

Both Wiggins and Brewer were anxious to bring back to the ARL for a time a former Director, G. Dallas Hanna of the California Academy of Sciences. His broad knowledge and experience, his tact and diplomacy, his great scientific capabilities, and his manual dexterity and ingenuity in regard to mechanical problems were all recognized as highly desirable. This was arranged, and Dr. and Mrs. Hanna arrived on November 2 and immediately went to work, especially with guiding the overhaul of ARL transportation items such as weasels and in starting a geologic program through the study of bottom samples collected through the ice of lakes and the ocean.

One of the early efforts of the new DARL was to increase the salary and formalize the title of Administrative Assistant to the DARL, Otto Lombardo, who had served in the capacity, although without the title, for a long time. That was accomplished in October 1956. Nevertheless, Lombardo for personal reasons found it necessary to resign in March 1957. He had served with distinction for 37 months, and all were sorry to see him leave. His duties were assumed by Jack Baker, formerly a General Services Officer of the Geological Survey.

One of the most pressing and fundamental problems that faced the new DARL was the whole relationship at Barrow between the ARL and the Air Force and its contractors which were concerned with DEW Line support. The basis for the relationship was an agreement reached on

December 6 and 7, 1954 in regard to use by the Air Force of the Barrow facility of the Navy. Very briefly, the agreement was that Navy items of equipment and supplies would be transferred to the Air Force. Other items such as the power plant, shops, mess hall, laundry, and gas distribution system would be permitted to the Air Force but title would be retained by the Navy. Still other items that would be of use to the ARL were retained in whole by the Navy. The Air Force agreed to furnish logistic support to the ARL without charge in recognition of the items it received from the Navy. The trouble was that by 1956 many of the Air Force and contractor people at Barrow either had forgotten or were ready to ignore the 2-year old agreement.

Dr. Britton wrote Brewer on September 18, 1956 and informed him of some aspects of that agreement and instructed him to take certain steps to see that the interests of the ARL were protected. For example, that letter stated "In view of the pressing need for weasels and spare parts by the DEW Line contractor, several weasels were loaned by the ARL to the contractor and access was permitted to the ARL stock of spare parts needed for weasel repair and maintenance. It is decided by the Office of Naval Research that all vehicles loaned to the contractor be put in good operational condition and returned to the ARL at the time of termination of the contract or earlier if possible. It is also desired that in view of the difficulty of obtaining weasel spare parts the ARL stock be replenished by the DEW Line contractor in advance of the completion of their contract."

A letter from the DARL to ONR a few days earlier reveals something of the feelings. "It seems that they (the Air Force) are planning on putting up with ARL if we don't get in their way, but little else. Possibly this is the time to let it be understood that we are not in a begging position much as has occasionally been the impression given us by earlier contractors and even WECO (Western Electric Company) on occasion.

"I believe that ARL needs all the buildings on the present inventory, and an effective logistics agreement for maintenance of personnel, buildings, and transportation facilities. From what I have seen over the years and now, it seems evident that such an agreement needs teeth—that can be smilingly reviewed occasionally by each new Commanding officer and/or Camp Superintendent. . .

"As usual transportation is a headache. Eight weasels were on the fritz this morning and the Contractors do little to repair them other than to let them set in the breeze for a couple of weeks until somebody here blows a fuse. Then they rush them in one door of the shop and out the other with little more than a pat on the back pontoon."

The DARL was also concerned about, and active in procuring, either by purchase or from materials left by the oil-exploration program at Barrow, many other items needed immediately or to be needed later by the Laboratory. These included such items as drilling equipment, large-size tires for use on wheeled vehicles along the beach, and materials to build a proposed greenhouse. One of the problems was the getting back

from the Air Force contractor some quarters that had been loaned by the ARL. It was apparent that they would be needed by married couples and to take care of the few women investigators who were expected in the future, following a successful project led by a woman scientist in the summer of 1956.

During the late fall, repairs and maintenance work were carried on as opportunity offered, and the jockeying continued with the Air Force and the Air Force contractor for the best servicing possible for facilities and equipment. The DARL expressed the sound policy—"I believe in maintaining a moderate supply of good equipment in good repair and reducing any large quantities of stuff that is either junk or won't be used in the foreseeable future, say 5 years. This same thinking is being applied to my dealing with surplus lists in that I have been asking what can we use it for rather than thinking it might be a good thing to have around the house."

He also commented "I have heard a lot of griping against both WECO and the Air Force from other government agencies. . . . Should we ever get in a position that we can't deal as equals, i. e., the Navy have something that the Contractors and/or Air Force need, we would be in a tough spot. Right now the Navy is sitting pretty with a 60-day revokable custody deal on the Camp. However, I understand the Navy would like to give the Camp to the Air Force. If this happened we could end up in a squeeze."

W. B. Girkin, an ONR procurement and supply official, arrived at the ARL late in August. He inspected the physical property and checked

inventories and stockroom supplies. He also held a series of conferences with Contractor representatives in connection with property loaned by the ARL and expected to be returned or replaced. Also in August, 94 pieces of surplus equipment and supplies reached the ARL by way of the annual ship expedition. Many more came in by air. One item of special interest was a Model-J Muskeg tractor to be tested as a replacement for the weasel. The winterizing of mobile equipment began in September with the plan that the winter fleet would include 7 weasels, 2 jeeps, and the Muskeg tractor.

In October began the repair of buildings. "The wood-work around the library windows had become badly split and was replaced. The walls and ceiling in about half of Building 250 were washed in preparation for painting and the remodeling of the living quarters in Building 251 was initiated. One-half of Family Hut No. 4 was returned to ARL control late in October. The contractors painted this apartment and assisted ARL in furnishing it in preparation for its occupancy by Dr. and Mrs. Hanna."

During November the repair of ARL vehicles continued, and the completed ones were placed in a "dead line" for use in the summer of 1957. Also WECO and Puget Sound and Drake officials were reminded that certain fuels belonging to ARL were stored with contractor's stocks and would be reclaimed. Also the contractors were informed that they would be expected to replace ARL lumber used in early stages of DEW Line construction. Among many other improvements, carpentry in the

hallway of Building 251 was completed. Each room was enclosed in masonite so that hall lights and noises would not disturb the occupants. One half of the upper deck of the same building was made into rooms by plywood enclosures.

By Christmas the cleaning of walls and ceilings in all ARL buildings was complete, but the painting program was delayed by the non-arrival of the paint. All hands were ready to participate in the Christmas holiday festivities.

Around the middle of October the DARL really began to horse trade with the contractors and displayed the skill and finesse in that activity that has thereafter been of incalculable value to the ARL. On October 13 he sent two letters to Assistant Superintendent, Construction, of WECO in Barrow. One offered to help WECO by possibly taking over some items that might become surplus as WECO phased out and the new contractor, Federal Electric, phased in. The other letter reviewed again the commitment of WECO to return buildings, equipment, and vehicle parts loaned by the ARL to the DEW Line operator. He offered, though, to calculate a reasonable depreciation of equipment in the return, to consider certain substitution of items to be returned for other items borrowed, and especially to accept such things at Barrow as jeeps and power wagons instead of ARL weasels (that he knew to be essentially worn-out) at outlying camps.

They were good proposals, and they worked—the ARL gained mightily thereby.

On October 20 the DARL turned the screw another notch and requested the contractor to install a ventilation system in Building 251 which by then had been divided into laboratory rooms below and 12 bedrooms, a wash room, and a lounge above. The contractor replied by saying that it was not clear that such an installation came within the Navy-Air Force agreement and that the work might have to be paid for.

In January of 1957 the annual capital inventory, a major effort, was completed by Mr. Fredrickson, the Storekeeper. Also a floor sander and the paint arrived, and a good start was made on the inside painting. The following month began a project to concentrate storage so far as possible in Building 253 and a clothing room, paper room, camping-gear room, instrument room, furniture room, and marine room all were organized. Sand tires were tested and found to be very useful, at least in winter, thus allowing the greater use of jeeps and a saving on weasels.

Modification by the contractor of the Muskeg tractor that was under test was completed in March, and the vehicle was judged a satisfactory work vehicle for ARL investigators. Family quarters No. F and another building were returned to the ARL in March also.

A few of the summer investigators began to return in April, and the ARL was well organized and ready for them. By June the influx was on in earnest and getting the parties into the field required a substantial amount of bush flying. The ventilation system in Building 251 finally went into operation.

About September 1956 the ONR office in Washington began to press for more complete and more accurate monthly reports from the ARL. The effort has paid off over the years for a nearly complete record is available. It is easy to let slide such chores as monthly reports under the pressures of operating a facility like the ARL, especially in the summer with many parties in the field scattered over thousands of square miles and each pressing for special servicing.

Also in 1956, as a result of discussion between Dr. Britton and RADM (ret.) L. O. Colbert, Director of the Washington Office of the AINA, there began a custom, followed ever since, of having the Director of the ARL, or some other responsible ARL or ONR representative in attendance at meetings of the Research Committee of the Arctic Institute. The practice has been most useful.

In the fall of 1956 a small group from the ARL participated in the Alaska Science Conference, held that year in Juneau. The DARL recommended, following the conference, that much greater participation by ARL investigators be urged in the future.

The loss of Donald MacVicar by drowning in Chandler Lake already has been described. The tragic incident was closed in October by reports of additional searches for his body late in the fall by both Sigurd Wien, President of Wien Alaska Airlines and James Anderson, pilot. Early in October the lake was frozen, and the search was terminated.

Also in the fall of 1956 an administrative situation arose between the Geophysical Institute at the University of Alaska and the ARL. It always had been, and still is the practice of the ARL to furnish to ARL investigators, and to other approved projects, free logistics support, including transportation, board and room, and equipment. A Geophysical Institute group had used such services, and it was felt by the DARL that they should be paid for by the Geophysical Institute. The Director of the Institute, Dr. C. T. Elvey, thought that the charges were the responsibility of the ARL. The problem intensified because Wien Alaska Airlines was billing the ARL for transportation of Geophysical Institute people. This little incident resulted in care in the future to determine clearly, ahead of charges, what projects were ARL projects, what were ARL-approved projects, and what projects had no claim on the ARL.

In 1956 the U. S. International Geophysical Year organization approved a glacier project to be carried on in 1957 and 1958 on the McCall Glacier in the eastern part of the Brooks Range in Alaska. The organization scheduled to administer the project was the AINA and COL Walter A. Wood was selected as the organizer and director. The ARL wanted to be of all possible assistance to the project, but was understandably cautious about suddenly finding itself responsible for supplying the logistics. It turned out that most of the support was supplied by the Air Force. After repeated discussions, both face-to-face and by correspondence, Dr. Hanna

and the DARL visited COL Wood at Barter Island early in April 1957.

After that meeting the DARL reported to Dr. Britton—"I believe we will be able to cooperate whole-heartedly with the IGY group. We will have the use of each others' camps and equipment but each group will furnish its own supplies. I also believe that we may be able to work out a cooperative bush flight arrangement and in this regard, I plan to see Dr. Wood again the first of the week."

Another project of the IGY was the establishment of a station on an ice floe north of Barrow. This was first discussed with the DARL by a group of Air Force officers and civilians at the ARL in early November 1956. On January 9 Dr. Hanna reported that the station was 700 miles north of Barrow and that Barrow would be a relay station. COL (Dr.) Curry, Scientific Officer, told the DARL of a plan to first establish a practice camp a short distance off Barrow. By the end of February personnel were beginning to arrive at Barrow, and there were 26 shore-based people by Feb. 28. By late March the establishment of the station was underway.

On October 30, 1956 in Washington was held a meeting of federal agencies interested in the development for general use in the Barrow area of the nearby gas field that had been discovered during the Pet 4 operation and had been used only in the Pet 4 camp. The DARL was requested to give to a Dr. E. L. Krafts all possible assistance in identifying supplies

and equipment that might be useful in the gas development project. The study and planning went on for several weeks and then seemed to die down, perhaps because it was the winter season. The matter came up again around the middle of May 1957, and ONR was informed by CAPT A. S. Miller, Director Naval Petroleum and Oil Shale Reserves, that R. M. Carberry of the Penero Engineering Company would be in Barrow during June to investigate the project further.

Late in 1956 also arrangements were made for accommodation of ARL investigators in DEW Line sites under appropriate controls.

In February 1957 Dr. Walter A. Wood, Chairman of a committee of the Arctic Institute of North America to advise the ONR in regard to the program of the ARL, wrote the CNR and suggested a visit to the ARL, the Defence Research Northern Laboratory of the Defence Research Board of Canada at Churchill and Thule to review and compare the research programs at those places. He suggested the trip be in the spring of 1957 and that some members of the AINA committee go along. He also suggested others such as representatives of Canada, of ONR, the Army, DOD, and a few selected because of their special interests and experience.

The suggestion was attractive to ONR and on April 1, 1957 the Chief of Naval Research informed the CNO of a plan for an advisory committee of American and Canadian officers and scientists to visit the DRNL at Churchill, the IGY and Army facilities at Thule, and the ARL. The CNR

requested the designation of a Special Air Mission for about twenty participants.

At first the plan was to leave Washington late in May and to return about June 8. By early May it was clear that it would be wise to await the availability of a 4-engine aircraft (R5D) expected to be available about mid-August. The CNR requested the Arctic Institute to arrange travel orders for the civilians and to coordinate with ONR on detailed arrangements.

Around the middle of July it became known that another delay to mid-September was inevitable and soon September 23 to October 6 was decided upon. Also the purposes of the review were specifically defined as—1. to obtain a better appreciation of programs and facilities for arctic research by on-the-ground review by civilian and military personnel; 2. to appraise past research, evaluate current programs, and make recommendations for future research; 3. to stimulate joint efforts and coordination of U. S. and Canadian research; and 4. to ascertain the nature of potential facilities for future research.

The trip started as finally planned on September 23 and informative and useful stops were made at Ottawa, Fort Churchill, Thule, Barrow, Ladd Air Force Base in Fairbanks (now Fort Jonathan Wainwright), Kodiak, and Seattle. The aircraft returned to Washington on October 4.

The study-group trip was considered a great success. Under cover of a letter to Admiral Bennett dated October 25, 1957, Walter Wood

reported on several findings from the trip although he stressed that the overall report was being prepared by a so-called Executive Group of five, chaired by Mr. Paul Queneau and including Captain J. C. Myers, Dr. T. J. Killian, and Dr. Louis Quam, all from ONR, and Dr. John C. Reed of the U. S. Geological Survey and Chairman of the AINA Research Committee. In his October 25 letter Wood summarized the views of some of the AINA Governors under three points: 1. Need for improved coordination of planning and operation of research activities between the three military services, 2. steps should be taken "to insure that the nation's best scientific effort goes into that area," and 3. the program is inadequately financed, and this should be remedied.

The report of the Queneau committee, in the name of the group, was submitted to ONR under the same October 25 date. The summary and recommendations were brief and dwelt on the military significance of the Arctic and the consequent research program needs. The Arctic was described, not as a barrier, but as "a highway to those who have the wit to use it". Regarding arctic research, the summary concluded that "the quality of arctic research being conducted ranges from high to low and its quantity is unacceptably small". It averred that "expanded arctic research is essential" and that reliance could not be placed on "arctic research by private enterprise since it has insufficient economic incentive to warrant rapid, large scale expenditures of funds for scientific

investigation of snow, ice, and related phenomena and for basic geophysical research of problems peculiar to the Arctic . . . the volume of such research must be sharply increased." The report concluded with recommendations for a major increase in arctic research funds and for organizational changes to plan and monitor the program. Lastly, it recommended "complete integration of the American and Canadian research efforts".

Attached to the report summary were nine appendices containing detailed evaluations and conclusions regarding program needs in several areas. These included ice, oceanography and bathymetry, land forms, meteorology, geophysics, biology, ecology and human factors, plus also communications, navigation and detection, and logistic needs. The introductory appendix set forth the committee's views on the importance of the high arctic to North American defense. The action recommendations were geared to that analysis. The philosophy of the report was indicated in the last paragraph of the last appendix:

"In addition to increased fundamental and applied research in the arctic environment, two corollary segments of research are needed in the Far North. The first of these is the need to carry on basic research in order to train scientists in arctic research, and the second is to develop new methods and techniques of research especially adapted to arctic work."

The report turned out to be an especially influential one and seems to have resulted in more attention to arctic research and more support than would have been given without it. On November 21, 1957, for example, the CNR wrote the CNO and said in part--

"2. I concur with their (the Arctic Research Advisory Committee) recommendations and the thoughts that inspire them, primarily--'the Arctic is a highway to those who have the wit to use it!' Fundamental know-how of the Arctic Ocean Areas is sadly lagging the epochal capability of submarines to travel under ice as demonstrated by the Nautilus. We must have that wit and know-how which will only come from a greatly expanded research and survey program in the Arctic Ocean Areas.

"3. It is recommended that you meet with suitable members of the Department of Defense for the purpose of discussing plans for implementing the recommendations of the Arctic Research Advisory Committee and that appropriate measures be taken to completely integrate the research and survey efforts of the United States and Canada in the Arctic Areas."

Subsequently an ad hoc working group to review the report was formed in DOD. On February 7, 1958 Dr. L. O. Quam, a member of that ad hoc working group, reported to ONR that the group concurred with most of the recommendations of the report and differed essentially only in that it did not think an Assistant for Arctic Research was necessary under the Assistant Secretary of Defense (R and E) as had been recommended in the report.

During the summer of 1957 there went on again what had become a chronic effort of the DARL to keep the Laboratory somehow supplied with vehicles so that transportation needs could be filled without prohibitive cost. As usual also the efforts were generally of two kinds--1. what could be obtained from the Air Force contractor by return of loaned equipment, by trade, by repair, or otherwise, and 2. what vehicles and parts might be obtained from outside northern Alaska by purchase or by acquisition of surplus items.

By way of the ship expedition to Barrow that year the ARL acquired 4 surplus jeeps, 4 surplus 3/4 T Dodge trucks, and a Muskeg tractor to bolster the rolling stock. Also oversize tires were acquired for 3 additional jeeps. One LVT was repaired and much of the armor plate was removed to make it a useful vehicle. In addition the Air Force contractor returned three LCM's and a D-8 Caterpillar tractor loaned for DEW Line construction.

After a good deal of wrangling with the contractor about the return of equipment, a meeting was held on August 21 in the office of the contractor, Puget Sound and Drake, at Barrow and was attended by the DARL. From that meeting came a proposed agreement for settlement with the ARL for equipment and parts used by the contractor. The agreement went into substantial detail, seemed fair all around, and was signed both by the Project Manager for Puget Sound and Drake, L. E. Hamilton, and by the DARL.

In a letter to W. B. Girkin, the ONR Resident Representative in Baltimore, dated August 29, the DARL said—

"I suggest that the proposed agreement, a copy of which is enclosed, plus the surplus vehicles from Seattle, will fill ARL's needs for wheel vehicles, for the foreseeable future. The agreement is also one that PS and D can accept from a practical standpoint at the local level. I suggest that the general agreement be approved after it is carefully checked for wording since I tried to include several other points in the same agreement.

"The surplus trucks from Seattle were rebuilt and, with large tires, will be as good as anything in camp. The surplus jeeps from Seattle are basically better than any jeep in camp, however, they used cabs, heaters, and large tires.

"The proposed agreement will give ARL a total of six 4x4's and seven jeeps, all in good condition."

By mid-January 1958 the DARL requested Mr. Girkin to try to get Puget Sound and Drake actually to turn over to ARL the vehicles mentioned in the above agreement. However, only two weeks later he was able to report that PS and D was honoring the agreement, and the vehicles had been transferred.

In early June 1957 the DARL had learned of 130 weasels said to be available as surplus in Japan. He requested thirty of them as new stock or possibly for cannibalization. Then came up the matter of the cost of

getting such vehicles to Barrow. M. E. Britton in ONR did some checking and estimated the cost might be between \$500 and \$700 per vehicle from Japan just to Seattle. On learning this the DARL replied to ONR that fifteen of the weasels were essential, even if ARL had to pay the transportation cost. Next the DARL requested information on spare parts that might be surplus in Japan and mentioned his need especially for transmissions, sprockets, tracks, bogie wheels, idler tubes, and motors.

Near the end of October the DARL was informed that twelve of the weasels from Japan were being shipped to Seattle and that ARL would not have to pay for the transportation and that thirteen more were to be ordered and transportation would be paid by the University of Alaska contract with ONR.

More weasels and weasel parts were listed on surplus lists from time to time, and efforts were made by the ARL and by ONR whenever possible to obtain them with as little as possible out-of-pocket costs. Thus ARL learned of some weasels at Fort Churchill and in Michigan—parts in Philadelphia, and so on.

Eventually it was not required that ARL pay for the freight on any of the surplus weasels, and twenty-five arrived in Seattle from Japan and some additional ones from Michigan in time for the ship expedition to Barrow in the summer of 1958. The DARL immediately suggested that the funds in the University of Alaska contract that were expected to

be used for freight charges for shipping weasels be used to buy other badly needed laboratory equipment.

At the same time as negotiations were going on for the return of equipment from the Air Force contractor and for the acquisition of additional equipment, the DARL had to insure also the best use of equipment in hand and the best possible arrangements for its upkeep and repair.

In June 1957 he issued a notice to ARL investigators outlining the situation in regard to transportation equipment, requested cooperation in use of the equipment and in following a number of rules that he had drawn up. The rules would eliminate unauthorized use, would insure a fair distribution of facilities, would encourage combined use of vehicles, and would minimize idle time on equipment use.

In July 1957 even as the influx of investigators was beginning, the ARL staff worked over the ARL boat Ivik and had it ready for use by the end of July. Two dories and three skiffs were caulked and painted and placed at locations advantageous for investigators. Two laboratories and two apartments were repaired, painted, and readied for occupancy. In August general repairs continued on the buildings. Also some temporary employees were terminated as the season slackened. In that month also Dr. and Mrs. Hanna left for the States. They were sorely missed.

On September 5, Paul H. Tietjen, who had come to Barrow as a member of one of the research projects, was taken on the ARL staff as an assistant to the Director. As of December 18 he became the regular Administrative Assistant, replacing Jack Baker who had decided to leave northern Alaska. During the month the Ivik was out of commission while a new and more powerful engine was installed. Also in September was begun the construction of a greenhouse—long planned for the ARL. It is 16 feet by 24 feet and behind, but connected to, the laboratory buildings.

By the end of October the greenhouse was progressing, a major instrument wanigan had been brought in from near Point Barrow for overhaul, ARL personnel had collected several caribou for a natural-habitat group at Michigan State University, vehicles had been inspected and deadlined for the winter, and worn-out vehicles had been recommended for survey and abandonment. In November two wanigans, completely renovated, were moved to Eluitkak Pass near Point Barrow for activities in that vicinity. The two best weasels were overhauled and repainted for winter use.

In December was begun the annual inventory of ARL supplies and equipment. The report on animals for that month indicates something of that activity in winter---

"Mr. Harry Brower prepared and stuffed the many bird and mammal specimens which had been collected for the Laboratory during the summer

season. These will be added to the present Laboratory specimen collection for display and study purposes. Five caribou specimens were prepared by Harry Brower and Pete Sovalik and shipped to Michigan State University for display in a natural habitat group in the University Museum. Six live foxes were shipped to the Calgary Zoological Society, Calgary, Alberta, to be added to that group's live animal collection. The Laboratory still has two wolverines, two arctic foxes, a white owl, six marmots and many ground squirrels in its own live animal collection."

Ever since the DEW Line was constructed, researchers from ARL and elsewhere had cast jealous eyes toward using the facilities along the northern Alaska coast as centers from which to carry out research. Such assistance to scientists was resisted by DEW Line officials because of the importance and security aspects of their own work. ARL, or rather ONR, brought to bear a good deal of pressure in the summer of 1957. Some of the effort was in regard to specific project needs, and some was directed toward general permission to use DEW Line sites with details of specific projects to be worked out in the field. A general agreement was worked out in mid-June with some rather rigid and specific provisions. By the end of October consideration was being given to extending the agreement for the winter and the following summer and to extend the agreement also to include DEW Line sites in Canada.

During the summer and fall of 1957 the chronic problems arose again of how to handle visiting scientists and project personnel who landed

at Barrow unannounced and expected to be taken care of by the ARL. By 1957 the ground rules had been reasonably well established, and the DARL was usually able to make decisions without too much difficulty. Nevertheless, the handling of the individual cases was time consuming, and there frequently was doubt as to how their messing, billeting, and services were to be charged or whether or not they would simply be carried by the ARL. As usual there were several cases of the kind mentioned from the Navy Hydrographic Office. The diplomatic handling by the DARL is attested by a memorandum of appreciation from the Hydrographer to the Chief of Naval Research and specifically mentioning Mr. Brewer.

The plan to cooperate and coordinate with the Arctic Institute and the IGY in regard to the McCall Glacier study worked out well in the summer of 1957 although there was some concern as to how great might become the logistics problem in the coming winter (1957-58). Just after the middle of July the DARL visited the high glacier camp on the McCall Glacier and landed there in a Cessna 180. In early September a couple of men were sent into the area to close a nearby ARL camp for the winter, and to help winterize the IGY camp high on the glacier. A warm letter of appreciation for all the help rendered by the ARL and the DARL in particular was sent by COL W. A. Wood, the director of the McCall Glacier project for the AINA to the Chief of Naval Research.

Then in late October came word of the tragic death of Richard Hubley, the leader of the IGY party on the McCall Glacier under at first

unexplained circumstances. The DARL immediately stepped in to help. He wired the director of the project, Dr. Wood; the President of the University, Dr. Patty; and the man responsible for the ARL in ONR in Washington, Dr. Britton. Then he flew to Barter Island with the Territorial Police Officer from Barrow to be present when the party members were interviewed after having been brought out from the glacier camp. All this he did as a good will effort because the glacier project was not under the ARL, although local people in northern Alaska usually identified the group with the ARL.

The DARL found that a guiding hand was needed at Barter Island, and he took over in large part in directing the evacuation, first to Barter Island and then to Fairbanks. It soon became clear that Hubley's death was in fact suicide and not any development connected with the project.

It soon was decided that the station on the glacier would not be reoccupied at least until February 1958—the surviving men meanwhile would work on collected data at the University of Washington. Around the turn of the year energetic consideration was being given to reorganizing the project. Dr. Svenn Orvig, of McGill University, had agreed to assume the scientific leadership, although he would not be able to spend much time in the field. The DARL offered to be of any help he could in reestablishing the camp and helping out with logistics.

On behalf of the IGY, the DARL expressed the appreciation of all concerned to the personnel of the DEW Line. Special appreciation was

expressed to Major Parker, USAF; LaVerne Newell, Federal Electric Sector Superintendent; and Karl Luckhart, FEC Site Superintendent.

Toward the end of February 1958 the McCall Glacier camp was reopened.

In the summer and fall of 1957 an interesting negotiation had taken place between the ARL and the Federal Electric Company in regard to the use of FEC contract aircraft by ARL personnel. The privilege of using the contract aircraft was important to the ARL as it represented a considerable saving in transportation cost. On July 2 FEC issued a directive denying such use to the ARL and several other military and semi-military units. The Army chose to contest the directive on the basis that the government, in effect, was paying for empty seats on aircraft under charter and at the same time paying to send passengers by regular commercial flights. The DARL agreed with the Army position, but was cautious about criticizing FEC in view of the good working relationship between ARL and FEC. In a few weeks the privilege of using the contract planes was reinstated by FEC for military personnel only. The DARL then set about having all ARL personnel classed as "military" for purposes of charter aircraft use on the basis that all such personnel had Navy travel orders. This position he successfully defended.

The cooperative attitude and practice of the DARL in dealing with other groups did not go unrecognized and acknowledgments for his help

were continually being made. An example was a long appreciative letter from the Commander Amphibious Group One, Pacific Fleet, RADM F. C. Stiltner, Jr. that was sent to the DARL, the Federal Electric Superintendent at Barrow, and the Puget Sound and Drake Superintendent at Barrow on August 26, 1957 in recognition of help to the resupply expedition of that year which he commanded. That year also the Hydrographic Office and COL W. A. Wood of the Arctic Institute were also pleased to acknowledge the DARL's help. The DARL was still technically on loan from the Geological Survey, and Dr. L. O. Quam, Head of the Geography Branch of ONR, was careful to see that all commendatory letters regarding the DARL were sent to the Geological Survey for inclusion in Brewer's personnel file.

For a long time it had been increasingly clear that another boat, in addition to the small Ivik, was needed to carry on marine work that could be done from the ARL. The DARL summarized the situation in October 1957 by pointing out that, in addition to the Ivik, the ARL had only a few old, worn-out craft that had been earlier used in Pet 4. All except the Ivik were essentially junk. He requested consideration be given to acquiring a surplus Greenland cruiser—a wooden-hulled craft carried by some of the icebreakers. The Greenland cruiser is about thirty seven feet long with a draft of a little over three feet, a capacity of about twenty-five men, a speed of nine knots, with four bunks in the cabin, and with the hull sheathed for work in ice.

A good deal of investigation revealed that no Greenland cruisers were available as surplus and to build one would cost in the order of \$50,000 or more. A surplus motor-sailer, a larger craft, was found to be available, but was not so well suited for the needs of the ARL. The discussion went back and forth in correspondence between the DARL and ONR for months. On February 2, Brewer summarized again that---1. a stout boat is needed; 2. a Greenland cruiser is much preferred; 3. the motor sailer is acceptable if the cost of the Greenland cruiser would jeopardize the research program.

Information continued to build up in favor of the Greenland cruiser. One problem was whether or not a crane of sufficient capacity was available at Barrow to lift the craft out of the water, a total of about ten tons. By mid-February, it also was becoming clear that a Greenland cruiser could not be built and gotten to Barrow before the 1959 season.

In May the DARL visited naval architects in Seattle and discussed the plan to have a cruiser constructed. He settled on one who seemed most desirable to him. The architect would agree to:

1. Submit plans until they are satisfactory.
2. Assist in advertising for bids and awarding the construction contract.
3. Supervise construction and make periodic inspections.
4. Make final inspection and recommend acceptance of the craft.
5. Charge six percent of the construction costs for his services.

By the end of the financial year it looked as if the plan to proceed with the construction of a Greenland cruiser would move ahead as soon as appropriate official ONR clearances had been obtained.

The acquisition of two bush aircraft by the University of Alaska for the use of the ARL was negotiated in the first half of 1958. In January the DARL pointed out to ONR that a Cessna-type aircraft for the ARL would be a good investment because of the high cost of bush-plane charter. It was soon determined that some light Marine Corps aircraft might be available as surplus or on a loan basis. It later was found that the military aircraft could not be converted suitably for bush use and that thought was abandoned. Finally it was agreed that two aircraft, Cessna 180's, would be purchased by the University of Alaska in Fairbanks and equipped with a few special items that were deemed to be desirable for ARL use, i. e. skis, floats, large tires for landings on sand, extra heavy axle, etc. The ONR purchasing office was able to arrange a price reduction with the Cessna company that brought the cost somewhat below earlier estimates. Thus two new aircraft were assured for ARL use as soon as they could be delivered.

During the early spring of 1958 a good deal of charter flying was done for one of the projects out onto the pack ice. One of the pilots was Robert Fischer, a resident of Barrow. He soon became the choice of the DARL for the first ARL-employed pilot when and if aircraft were obtained.

Mr. Fischer's employment was processed by the University and was completed in June, as he is listed as an ARL employee in the report for that month.

In the 1957-58 year the subject of permitting wives of employees and investigators to live in ARL facilities again came up. A few comments on this general subject by the DARL will serve to point up the matter. In November 1957 he wrote regarding two investigators with whom he had "discussed the possibility of having their wives at Barrow and I described the facilities available to ARL, told them of the policy that women should be employed on a project, and also told them that the bringing of wives was discouraged. From an administrative viewpoint, and as long as the camp is operated as it is at present, I tend to favor several winter investigators having their wives here. The most pressing reason is that I am afraid that until we adopt this plan we will be hard-pressed to find good men to work here the year around, particularly when there are more comfortable areas in which to work, and where it is possible to take one's family. I believe that we should decide how important the project is and if it is of sufficient importance, provide an apartment for the couple. Secondly, a few wives at the Laboratory provide a much better atmosphere and help the morale of the group. Thirdly, if the wife cooks most of the meals at home, it costs less to maintain a couple at Barrow than it does a single man. . . These comments are meant to cover winter investigators,

in the main, and also to cover men whose presence at Barrow is very much desired.

"I am not much in favor of investigators living in the village (about four miles away) since this cuts their productivity and adds a very considerable burden to the transportation problem."

The subject was still very much on his mind at the end of January 1958 for then he wrote, especially in regard to the thought of bringing children to the ARL also---"I had thought that a young child would not greatly interfere with the work of a secretary since it would be possible to make arrangements for it to stay with one of the other families during working hours. The costs of maintaining a family continue to be less than maintaining a single man. I hope that the contract division will eventually be agreeable to more women working here as I believe that, since many investigators or potential investigators are marrying at a young age, our only hope of keeping many year-around physical scientists is to allow women at Barrow to the extent that the ARL facilities permit. PS and D is coming around to that view, and the DEW Line is once again seriously considering it."

The DARL in early January 1958 reported to the Comptroller of the University of Alaska, Harold A. Byrd, that the expenditures for the operating year August 1957 through July 1958 would be about \$152,500 and the available funds, \$153,000. The estimates did not include the

acquisition of a Greenland cruiser or other craft as already has been discussed. That possibility was covered by a budget addendum that anticipated the cruiser cost of operation would increase the ARL's needs by about \$4000 a year.

A little later in January, the DARL reported to the Geography Branch of ONR (Code 414-C), M. E. Britton, that the flying bill for investigators in 1957 had totalled approximately \$11,000. He anticipated that in 1958 the same service could be supplied for approximately fifteen percent less.

In February 1958 the idea of a new and permanent laboratory began to gain momentum. Dr. Britton wrote the DARL to report that with the help of BUDOCKS he had turned in an estimate of a requirement for a 35,000 square-foot laboratory at the cost of \$2,500,000. Mr. Brewer, who would shortly be coming to Washington for discussions, was requested to be prepared to justify the building. Britton requested—"It will be wise for you to prepare yourself to discuss the real needs of the laboratory as you see them and give some attention to tentative ideas on floor plans. One of the most urgent requirements is going to be a defense of the contention that permanent quarters are needed. It will be essential that we have documentary evidence of the existing plant, its disrepair and deterioration, and the large cost of repair and maintenance, and the like." The DARL understandably was pleased with the development and agreed to come in fully prepared.

Throughout the spring of 1958 the relationship between the ARL and the Air Force and its contractors---Western Electric Company and Puget Sound and Drake Construction Company---in regard to property and facilities came up again and again and as a result were reasonably well systematized, generally to the advantage of the ARL. In April the Air Force Contracting Officer, Major Arthur Schwartz, was contacted by the DARL relative to having certain wiring and plumbing maintenance and additions taken care of in ARL buildings. On the ground the Air Force contractor was unwilling to perform the services without cost to the ARL. Mr. Brewer took the position that such service clearly was covered in the Navy/Air Force agreement that permitted the camp to the Air Force. Major Schwartz agreed with the position of the DARL, and the contractor was instructed to supply the service free to the ARL.

Next Brewer turned to consideration of 53,000 gallons of aviation gasoline that the ARL owned at Barrow at the time the camp was turned over to the Air Force. His point was that the agreement called for the Air Force to supply fuel to the ARL so that perforce the 53,000 gallons of gasoline must still belong to the ARL. Then came up the matter of use of the Air Force camp at Barter Island. This was requested by the DARL in a letter dated May 26 to CAPT R. S. Pryce of the Federal Electric Corporation in Fairbanks.

The DARL requested ONR to ask the Director of Naval Petroleum Reserves, CAPT A. S. Miller, to seek the return to Naval Petroleum

Reserves of a good building at Barter Island from the Air Force. The building could then be turned over to ONR. This CAPT Miller agreed to try.

The DARL also was aware that Naval Petroleum Reserves really wanted to dispose of all the Barrow camp and equipment permanently and would like to give it all to the Air Force, rather than just permit its use to the Air Force. The DARL argued that it would be better to give control to ONR, which then could give an appropriate permit to the Air Force. His reasoning ran as follows—"I urge that ONR request that the camp be transferred to ONR. ONR could then license the Camp to the Air Force such as Pet 4 is doing now, and ARL would have no additional chores although it would be in a very favorable position to continue to receive logistics support from the Air Force. If the Air Force moves out we will want to maintain about a third of the Camp buildings and will have to maintain the roads, power plant, boiler house, fueling and water supply. Therefore, it is preferable that we have control of these portions of the Camp if we have to operate them. If the Air Force takes the Camp, they may decide that they are no longer obligated to provide logistics support for ARL. This would certainly increase our costs of operation. Also, some groups in the Air Force may decide to dispose of the Camp and then we would be faced with construction of new power facilities, some shops, and galley as well as storage buildings. Should neither ONR nor

the Air Force decide to accept the Camp, most of the buildings will probably be sold, and when the next crash program arrives, ARL will be under tremendous pressure to provide its facilities for the construction people and to curtail or temporarily eliminate its scientific program.

"I don't want to see the Camp destroyed and hauled to the Village as neither the Government nor the Navy will receive two cents on the dollar for the Camp, which although completely depreciated, has a great value for crash programs. I do not believe that the Air Force. . . can be counted on to retain the Camp intact. Thus, I see very little choice but for ONR for practical operation to take over the Camp if it plans to retain the ARL operation for any length of time."

As of early June 1958, the plans of CAPT Miller to dispose of the whole Barrow camp were delayed indefinitely as a Congressional committee was said to be interested in the matter. However, Dr. Britton was able to inform the DARL that CAPT Miller understood his position and that he wished to be cooperative.

As early as the end of April 1958, the DARL in a letter to a potential investigator pointed out that floating Station Alpha was breaking up and would likely soon be abandoned. He said the floe was badly cracked, one third of the runway was separated by an open crack from the west, and most of the camp personnel were involved in camp maintenance rather than in their research work. Also about the same time it was learned

that the icebreaker Burton Island would be in the Arctic Ocean during about a month in August in support of an oceanographic program.

Mr. Brewer at the end of May requested the approval of ONR to allow Dr. Erwin Schenk, a German geologist, to visit the ARL for about three weeks in August. Dr. Schenk had been there the year before, and permission was readily granted.

By July 1958 a gas line from the South Barrow gas field that was discovered during Pet 4 was laid about six miles to the village of Barrow where it went into use providing heat and power to government installations there. These included among others the school, hospital and Weather Bureau. Thus, the South Barrow gas began to be shared by the village and by all the facilities at the old Navy camp, including the ARL.

In November 1957 the CNR urged the CNO to permit continuation in 1958 of the ice-reconnaissance and forecasting program. He pointed out that the program would aid research activities designed to improve ice forecasting and that the results would greatly assist increased arctic research designed to further exploit the capabilities of nuclear submarines. This plea was repeated in early March 1958 at which time the CNR also recommended aerial cameras and aerial radiometers be mounted in the ice reconnaissance aircraft.

The ONR agreed in April 1958 to continue to assist the Geomagnetic Observatory of the Coast and Geodetic Survey at Barrow. Support had

been given to that observatory during the IGY, and ONR was interested, as was the Coast and Geodetic Survey, in continuing the observations.

A few items gleaned from the monthly reports of the ARL for the six months—January through June 1958—will serve to indicate the sort of activity carried on by the ARL staff, as distinct from the research activities, during the winter months preceding the summer research season and including getting the summer research projects into the field.

During January some trucks were remodeled and painted. Large tires were put on, and a new cab was built on one. In the shop were built a storage rack, a lumber rack, and bins for small items. A good deal of needed interim painting was done. The annual inventory was completed.

In February the shop was further improved by construction of lavatories, a new floor, and a tool bench. Renovation began on the offices in building 250. An oceanographic project was assisted by arranging for the use of two small aircraft for ice landings and by providing field gear including construction of thermometer cases and the modification of a power winch.

Work on vehicles continued in March, and three jeeps were painted inside and out. Renovation of the offices was completed. A complete kitchen was installed in one of the family huts. A start was made in placing an acoustical-tile ceiling in the dormitory hall of building 251.

In April, storage areas and the connection between building 250 and building 251 were painted. An aerial-photograph storage room was built.

Four jeeps acquired the previous fall were stripped of non-essentials and painted, and hot-water heaters were installed. At the request of BUDOCKS a hole twenty one feet deep and thirty two inches in diameter was drilled with a power auger to determine permafrost conditions.

Three remaining trucks were modified in May for summer work. Heaters were installed, wooden cabs were built, large tires were put on, and the trucks were painted. The power auger and its operator were loaned to the Weather Bureau to assist in the construction of the gas pipeline to the village. The LVT made a trip of 150 miles over the tundra with several early investigators. The augmentation of the staff was begun by the hiring of Eskimos for the summer rush to come.

In June the rush was on. Thirteen field parties were equipped, and field camps were set up at nine locations hundreds of miles apart. Twenty investigators started or continued their research, and the ARL supplied eight man-weeks of labor in the form of field companions for isolated scientists. A staff member was fully occupied in the shop constructing various items of special gear needed, and the usual help was given by the storekeeper, shop foreman, administrative assistant, and the Director. The launch Ivik was refitted in preparation for the open-water season. Included were a new foredeck, a new cabin, new operating controls, additional gasoline tanks, a new steering arrangement, a remote-reading compass, a new radio transceiver, and

repainting. Many building improvements were made. Two thousand yards of gravel were dumped behind the animal house. Thus it went—a busy time indeed!

THE RESEARCH PROGRAM IN 1957

The research program for the ARL, as has been noted, was arrived at by a process of applications, review, and approval. For much of the program the Arctic Institute of North America provided planning, screening, and advisory services. Also, under contract with ONR, it actually dispensed the funds to recipients through subcontracts. The 1957 program was being planned during the summer of 1956, and applications were considered by the Arctic Research Laboratory Subcommittee of the Arctic Institute's Research Committee. Correspondence in the spring of 1956 indicated some lack of complete satisfaction with the Subcommittee and its activities. This related to the need for more vigorous planning and stimulating of the research program. Consequently, some changes in the membership were made and plans were pushed to have the members visit the arctic areas involved in order to stimulate interest and to assist in the evaluation of projects needed for a balanced program.

In a letter of September 24, 1956 from the Director of the Washington Office of the Arctic Institute to the Chairman of the ARL Subcommittee, mention was made of six projects that were active in the current year that were proposed for continuation in 1957. A Subcommittee meeting was called for November 23 to consider applications in hand. John C. Reed, who was Chairman of the Arctic Institute's Research Committee and also a member of the Subcommittee, urged that the latter consider means to

make improvements which would be in the direction desired by the Geography Branch of ONR.

In its meeting on November 23 the Subcommittee recommended and approved 15 projects at sums ranging from zero for Dr. Hanna to \$20,000 for the project of Dr. Thornthwaite. Most of the projects approved were not new to the ARL. Among those approved were those of William Boyd, Frank Pitelka, Ingrith Deyrup, Keith Hussey, J. C. F. Tedrow, C. W. Thornthwaite, and William Maher. Also among the approved projects were those of G. Dallas Hanna, Paul D. Hurd, Royal E. Shanks, Gesa Teleki, E. G. Sable, Laurence Irving, J. M. Campbell, and R. C. Miller. Applications for two other projects were received during the winter from Leonard R. Freese of Houston, Texas, and John E. Cantlon of East Lansing, Michigan. In addition to the above projects within Arctic Institute aegis were others arranged directly with ONR. Some of them also were continuing programs.

Some research projects remained active at the ARL during the winter-spring months of 1957. Thus Dr. Boyd continued his work on soil microbiological studies; Arthur Franzke, under the direction of Victor Hessler of the University of Alaska, continued earth-potential studies; and the arctic ice and permafrost measurements continued at Barrow and also at Fairbanks and Glenallen, with the assistance of the Army Corps of Engineers and the Bureau of Public Roads. Brewer, himself, directed

the project. Marshall Schalk also continued his beach and near-shore studies for the Woods Hole Oceanographic Institution, and Alan Beal continued his tide- and sea-valley studies for the Scripps Institution of Oceanography.

During March Robert Stark, University of Alaska, installed equipment and an antenna and undertook observations in pursuance of a forward-scatter project. Mr. Franke of the Geophysical Institute staff assisted him.

John L. Mohr of the University of Southern California arrived at the ARL in mid-April and spent two weeks on his project, Ecology of Crustaceans. His efforts to observe bow-head whaling and gather parasitic materials came to naught because of destruction of most of the whaling fleet in a severe storm. His other objective of sampling in deep water provided samples which later were analyzed.

With a few exceptions the major research projects which had operated out of the ARL in 1956 were continued in 1957. The exceptions were: the Montgomery bumble-bee project, the Langenheilm amber project, the Dutcher coal project, and the MacVicar geology project. In the latter case one of the members of the 1956 party, John M. Campbell, returned for a continuation of the archaeological investigations he had pursued near Chandler Lake. There were, of course, some changes in the investigative personnel on some of the projects, but most of the researchers were returnees.

The following projects were continued:

Sea Valley and Tide Studies, with Alan M. Beal and John Sherman III; also Robert L. Fisher and George Shumway. Martin Johnson, also of Scripps, was with the group making marine biological studies.

The study of the Ecology of Microorganisms by the Boyds.

The Metabolism of Tissues, Ingrid J. Deyrup.

Keith M. Hussey with John O'Sullivan and George Rosenfeld, studies of Geomorphology and Geological History.

William J. Maher, Ecology of Jaegers.

Pitelka, Ecology of Microtines, with Thomas J. Cade, Elbert M. Brock and H. E. Childs, Jr.

Beach and Near Shore studies, Marshall Schalk, with the assistance of David Schalk and Paul M. Tietjen. The latter remained at the ARL as an assistant to Brewer.

Tundra Vegetation of Alaska, Royal E. Shanks, with John J. Koranda and Ed. C. Clebsch.

John C. F. Tedrow, with Lowell Douglas, James V. Drew, R. B. Alderfer and Jerry Brown, the Soil Forming Process in the region.

Geza Teleki, Sea Ice Forecast, with Paul B. Swenson and Ensign R. L. Bunger of ONR.

C. W. Thornthwaite, Microclimatic Investigations, with William J. Superior, Henry Hacia and Mike Mijake.

Arthur R. Franzke, Magnetic Radiation Studies, assisted by Robert Leonard and Richard N. Shoup. M. J. Brewer, Permafrost Studies,

J. F. T. Saur, Thermal Radiation Studies.

During 1957 also Dr. G. Dallas Hanna and Mrs. Hanna returned for geological investigations and for the pursuit of many extra-curricular activities connected with his special talents.

The year before the Navy Hydrographic Office had sent Dan Olds and Ed H. Leeman to Point Barrow to carry out hydrographic studies. In 1957 Leeman returned with a team headed by W. L. Brock, and including Edward W. Johnson and C. B. Duff, in order to prepare for the IGY by the installation of automatic weather stations.

In June 1957 John E. Cantlow and his assistant, William T. Gillis, arrived from Michigan State University to pursue vegetation studies in the ARL area. Since their project had some relationship to the Tedrow soil studies and also to Thornthwaite's microclimatic investigations, a certain degree of cooperative operation was developed.

A new project in 1957 was that of Dr. Robert C. Miller, from the California Academy of Sciences, of studying the Effects of Radar on Birds. Preliminary findings based on cooperative efforts with the U. S. Air Force were negative.

A geologic team from the Geological Survey spent June 10 to August 24 in mapping and geological field studies in the Mt. Michelson area. Edward Sable and G. J. Kunkle were the investigators.

The Naval Electronics Laboratory sent John M. Hood to Point Barrow for a two-weeks' study of Arctic Visibility. During the period May 17 - June 3 he conducted studies of cloud cover, atmospheric conditions, and other phenomenon which might warrant longer range investigations.

On October 4 Navy ice observers James U. Brooks and John D. Mulhearn arrived at Point Barrow to begin a sea-ice freeze-up study for the Hydrographic Office. Daily observations were made at three points until November 13, when the investigators returned to Kodiak.

In addition to the above investigations certain preparations were being made at the ARL for the upcoming IGY. One of these, the installation and equipping of a magnetic observatory at a new site on a beach ridge, was initiated in March. The project was directed by Ralph Z. Barola of the Coast and Geodetic Survey. He was assisted by Frank Lampe, William Schneider, and Lloyd E. Gill. Operation of the magnetograph was complicated by movements of the piers of the building at the observatory site. Also in connection with the IGY, the Hydrographic Office in June sent Donald B. Gerson to the ARL to study ice deterioration and breakup by means of time-lapse photography.

In preparation for observations to be undertaken during the IGY on ice-floe stations, the ARL was visited during the period May 14 - May 21 by Norbert Untersteiner (later of the University of Washington) as part of

the so-called Ice Skate Project. Untersteiner, accompanied by Kenneth Hunkins, returned for two days in September for additional observations.

Another noteworthy aspect of the 1957 research program was the reoccupation of the ice-island T-3, which had been occupied in 1952 by the Air Force, under LTCOL J. O. Fletcher. The ice island was then near the North Pole ($87^{\circ} 54'N$, $156^{\circ} 30'W$). It was occupied continuously until May 1954, and was briefly reoccupied from April to September 1955. During the period of occupation, geophysical and meteorological data had been collected by A. P. Crary and by the Air Weather Service. As part of the IGY program T-3 was reoccupied in March 1957 and was called Station Bravo. Since 1952 it had drifted southward and during the 1957-1960 period of occupation it drifted around the periphery of the Beaufort Eddy and eventually ran aground north of Point Barrow near $71^{\circ} 51'N$, $159^{\circ} 45'W$.

During 1957 also the IGY stimulated other research projects in the arctic basin. The Alaskan Air Command also established station Alpha on drifting ice in April 1957. Under Project Ice Skate station Alpha was occupied for 17 months before breakup of the ice floe forced evacuation on November 6, 1958.

The year was, on the whole, a very productive one for most of the projects operating at or out of the Laboratory. As previously noted, most of the projects were continuations of research begun earlier, and the 1957 research produced additional and valuable data. One of the features of the

1957 field investigations was the development of extensive cooperation between teams working on different projects. Thus, for example, Royal Shanks' investigations into the tundra vegetation led to field cooperation with the Boyde who were studying the ecology of microorganisms, with William Maher, who was interested in the ecology of jaegers, with Hanna in some of his many activities, and particularly with the Tedrow group which was working on its soils project and was interested also in vegetation. The Thornthwaite microclimatic observations also were of interest to these many investigators.

The results of the 1957 research were partly put on display at the Eighth Alaskan Science Conference held in Anchorage in September. Mosere, Beal, Maher, and Schalk attended the conference with Director Brewer. Beal and Schalk read papers.

THE RESEARCH PROGRAM IN 1958

In 1958, as in 1957, the research program was planned by a combination of methods. A large part was arranged under the ONR-Arctic Institute umbrella contract involving application by the principal investigator, review and evaluation by the AINA committee system, and final concurrence by ONR. Other projects, as before, were arranged directly between ONR and the interested agencies and institutions.

The 1958 program was being planned, of course, during 1957. Proposals were submitted to AINA or were discussed with ONR, Geography

Branch, early enough to permit detailed plans and preparations. By letter of December 20, 1957 the Arctic Institute proposed to ONR that ten listed research projects be approved for support in 1958. Eight of the ten were renewals of investigations pursued in 1957. The proposed financial support totaled \$47,540. During the next few months, four projects were added, of which one was a renewal.

During 1958 also, the IGY produced considerable additional activity at ARL, and the concerns voiced by the study committee in October 1957 became an additional spur to many projects by defense and other agencies. The ice stations, Alpha and Bravo, became part of the considerable IGY research effort in the Arctic.

The 1958 research program was a greatly expanded one, for the reasons mentioned, and the expansion was mainly outside the ONR-AINA sponsored category. Of the 1958 projects there were twelve repeaters from the year before. These included the projects of:

Beal	Pitelka
Brewer	Sable
Cantlon	Schalk
Franzke	Shanks
Hussey	Tedrow
Maher	Thornthwaite

The IGY Magnetic Observatory operation under Ralph Barela also was continued. The IGY project of Time-lapse Photography of Sea (and

lake) ice initiated by Donald Gerson of the Navy Hydrographic Office in 1957 was continued by Brewer himself.

Among the new projects in the ONR-AINA program was a study of Eskimos on Barter Island by Dr. Norman Chance of the University of Oklahoma. His study concerned a "change and community organization."

Another project, for which Dr. Timothy Myers of the University of British Columbia was principal investigator, concerned the Behavior of Elder Ducks.

James V. Drew, who had done field research in arctic pedology as a member of the Tedrow group from Rutgers University, returned to ARL in 1958 to continue his studies, but with his own contract, since he had moved to the University of Nebraska.

Another new project involved The Rate of Endogenous Oxygen Consumption in Various Tissues of Arctic Animals and was carried on by Alton K. Fisher, from the State University of Iowa. He was assisted by Joe Hancock and Larry Nash of the same university.

The U. S. Public Health Service sent Dr. A. C. Allison, assisted by B. S. Blumberg, to conduct a study of the Physical Anthropology of Eskimos, and Dr. George Ball of the University of Alberta and Dr. Carl H. Lindroth of the University of Lund, Sweden, conducted Entomological Studies.

Additionally, a Duke University project in biology, with Dr. W. D. Billings as principal investigator, was carried on by Edward E. Clebeck.

Another AINA project in marine biology was pursued by T. Saunders English and William Neuffer. The work was done at station Alpha.

Two other new projects in the field of biology were the Lichen Survey conducted by John Thompson of the University of Wisconsin (an ONR-AINA project) and a Botanical Survey by Hansford Schaklette of the Geological Survey.

During 1958 the Hydrographic Office sent several investigators to Point Barrow to carry on oceanographic studies of different types. One team studied the ocean freezeup, and consisted of Nicholas Wilson and Carl Trombley. Warren Landlette did research on underwater sounds, and Robert Starr became a member of a nine-man team led by George Shumway of the Navy Electronics Laboratory making other oceanographic studies. The Shumway team included two from the Scripps Institution of Oceanography, Dr. Robert Fisher and Park Richardson; four others from NEL, John Beagles, Howard Chubb, Carl Shippek and Frank Vestecko; as well as George Dowling from the Navy Mine Defense Laboratory. William Maloney of the Hydrographic Office also conducted Acoustic Propagation investigations as part of the IGY program in connection with the ice stations.

While the oceanographic studies were being pursued, the University of Alaska team under Harold Peyton carried on investigation into the Structural and Mechanical Properties of Ice. Stephen Nathanson and

Patricia Peyton assisted in the project. Toward the end of the year a project at the University of Washington, with Dr. P. E. Church as principal investigator, began field work at the ARL, with Laurence Lyons at the Laboratory.

The National Bureau of Standards participated in the 1958 program through a three-man team of Harry Petrie, Hans Bengaard, and Wesley Daniels, who were engaged in ionospheric research. The Air Force contributed a VHF Transmission Survey by Kurt Toman. Lastly, the Navy Electronics Laboratory sent C. Norman Hicks to the ARL to take measurements of the "heat budget and radiation".

In total there were 33 projects in operation in 1958, in addition to individuals and teams which came to carry on other activities, such as inventories or brief surveys. Approximately 75 persons were involved in the on-the-spot investigations. Some principal investigators were represented at ARL by assistants.

The 1958 program was the most extensive one up to that year. The Laboratory reported in September that August had been the busiest month in ARL history. Field parties were scattered among numerous locations, including Mancha Creek, Jago Lake, Opilak Lake, Barter Island, Sagavanirktok River bluffs, mouth of the Colville River, Umiat, the Meade River, Kaolak River, Cape Simpson, Wainwright and the Pitmegea River. "In addition, the Schrader Lake, Cape Thompson,

and Kotzebue-Noatak areas were investigated for evaluation as to future research potential for ARL projects," according to the August Monthly Progress Report. The Laboratory had 52 investigators and visitors in camp at one time during the month.

As has been noted, many of the 1958 research projects were continuations from 1957 and earlier. Most of them (Cantlon, Hussey, Pitelka, Sable, Schalk, Shanks, Tedrow, Maher, Thornthwaite) were ONR-AINA supported projects. The Sea Valley and Tide Studies of Beal, Brewer's Ice and Permafrost study, and the Geophysical Institute's Aurora and Earth Potential observations had also been underway for more than a year. Some of the new projects were related in some way to existing projects. Thus Timothy Myres' investigations of eider ducks were in some respects related to William Maher's research on the pomarine jaeger, which in turn was part of the complex of studies of microtines, lemmings, etc., of Pitelka's group. The eider ducks and the jaegers are predators on lemmings, for example. The studies of the Shanks, Tedrow, and Thornthwaite groups were also interrelated to a degree, and were in turn of interest to the Pitelka study.

The Norman Chance study of changes in the community organization of Eskimos at a village on Barter Island was one of the few social studies that had been based at the ARL. The project of Dr. Allison also concerned the Eskimos, with emphasis on their physical anthropology. Three of the investigations were carried on by non-North Americans.

The 1958 program also saw an expansion of projects and researchers from agencies of the U. S. Government. Among the represented agencies were the Coast and Geodetic Survey, the Geological Survey, the Navy Electronics Laboratory, the Navy Hydrographic Office, the National Bureau of Standards, the Public Health Service, the Navy Mine Defense Laboratory, and the AFCRC.

FACILITIES VASTLY IMPROVED BETWEEN

JULY 1958 AND JUNE 1960

July 1958 was a busy month indeed for the ARL. Large numbers of investigators engaged in a variety of projects had arrived earlier, mostly in June, and were in the field or getting ready to go to the field. More arrived in July and placing field parties on location and maintaining those already out was a major and complicated task.

In mid-June 1958, Dr. Robert Rausch, Chief of the Zoonotic Disease Section of the Arctic Health Research Center at Anchorage, wrote the Air Force contractor at Barrow that he had examined the situation at the Barrow camp in regard to water supply and sewage disposal and that the practices were unsatisfactory and dangerous to health. He recommended that camp waste be taken out to sea and dumped, over the ice in the winter and by boat in the summer. A copy of his letter was sent by the DARL to Dr. Britton in Washington with the comment that, unless practices were changed, living in the area around the camp would become difficult.

About a year later in the summer of 1959, the Civil Engineering Laboratory at Port Hueneme, California, obtained a small sewage system and proposed to install it in the ARL building. That proposal was accepted gratefully by the DARL. Plans were made to install the system in September 1959 and to operate it on a test basis to July 1960. At the end of December 1959 the DARL wrote the responsible project engineer at Port Hueneme that the installation was proceeding satisfactorily.

In the summer of 1958, and continuing all through the two years described in this chapter, went on a continual jockeying match between the ONR and the Air Force in regard to the operation of the Barrow camp, the services to be supplied to the ARL, and the terms controlling the services.

The situation was initiated by the plan of the Office of Naval Petroleum Reserves to get rid of unneeded facilities, supplies, and equipment left over from the Pet 4 program. Proposal and counter proposal were made, modified, and then rejected by one or the other party. Meetings were held in Washington and in Barrow, but no real solution could be found. Meanwhile the old arrangement with the Air Force remained in effect, and the ONR was content, except for a few irritating points, to let it drag on. In all of this period of negotiation, although many Air Force officers involved apparently were incompletely informed on the background, the Navy was in an excellent position to negotiate. The Navy controlled the real estate as it is a part of NPR 4, the Navy had built and supplied

the camp, and the Navy had drilled the gas wells and controlled them.

An amusing incident in this whole matter was the discovery by the DARL that the Air Force had given to the Catholic Church at Barrow two quonset huts, used by the church for services, that were the property of the ARL.

Progress was made in the summer of 1958 in obtaining approval from the Air Force and from the Federal Electric Corporation that operated the DEW Line, for ARL investigators to be supported on appropriate occasions by the DEW Line stations. The general advice of ONR to the DARL was to make such local arrangements as he could for such support. A more general effort to open the DEW Line stations, meanwhile, would be pursued by ONR with the Air Force and with the FEC. As of July 23, 1958, the DARL was informed by ONR that authorization had been received from the 4601st Support Group, USAF, for the DEW Line to supply certain specified logistic support at DEW Line sites.

The ARL, soon after it started, began to develop a clear policy of assistance to and cooperation with others, government or private groups, who wished to work in the area. The evolving policy was remarkably liberal and has paid off handsomely, not only in good will but also in assisting various projects to accomplish much that otherwise would not have been possible. That policy developed a good deal during the two years covered by this chapter. The following listing of a few of the incidents will illustrate the policy and also will indicate that in total the services extended were substantial.

In June of 1958 an offer was made to the U. S. Public Health Service to receive two doctors, to provide them with logistic services and cold-weather clothing, to assist them in meeting the local Eskimos, and to help them in obtaining seal blood for study. Just a few days later the DARL agreed to have the ARL take care of two men from the 17th Naval District, Kodiak, who wished to come to Barrow to inventory camp facilities. In July began an influx of oil-company representatives who were interested in appraising the oil potential of northern Alaska in view of the plan of the Interior Department to rescind Public Land Order 82 that had closed to entry all of northern Alaska. The influx required some consideration, and ONR stated a policy that "This office wishes to be helpful and at the same time does not wish to be in the position of operating hotels." A great deal of responsibility and authority was given to the DARL to use his judgement in such matters.

The DARL also was authorized to work with the Arctic Institute, the AF Geophysics Research Directorate, and the Geological Survey in coordinating services to field parties in northern Alaska, especially air service. In July 1958 specific services were supplied to the Soil Conservation Service, the Scripps Institution of Oceanography, the Geological Survey, and others.

In May 1959 were authorized the visits of two scientists from the National Bureau of Standards to visit NBS projects at Barrow. They

would be provided for by the ARL. Similarly in late April an officer of the Coast and Geodetic Survey was welcomed at the ARL while he visited the Survey's Magnetic Observatory in the vicinity. Substantial help was given in April also to a team of television producers for the Columbia Broadcasting System. Several Geological Survey parties on the north slope of Alaska were assisted very materially. Just one letter, dated May 13, 1959, will illustrate the point; it is from the DARRL to Frank Riddell of the Geological Survey at Peters Lake far to the east of Barrow and not far from the Canadian border in the Brooks Range —

"We are forwarding a supply of groceries made up by guess. Another plane will be in on the 27th or 28th and we would like you to send back by the pilot a list of the groceries and/or supplies needed then. The supplies then will include the cable and stovepipe reducer Bill Holmes asked for in the letter just received.

"We will send a carpenter in on the 27th to help put up the new building and winterize the old one. We have redesigned the new building to fit the long term scientific requirements in the Peters Lake area and purchased lumber accordingly. The building should be 12 feet by 20 feet, should have its foundation on blocks (one 10" x 10" block on top of another to give an air space under the building) well dug into the ground level, and be completely insulated. We don't want the building connected in any manner because of the inherent danger of fire. A sketch of our ideas for the new building will be given the carpenter sent over to you.

"We will forward paint for both buildings later after it is warm enough to apply it.

"Did you receive the linoleum purchased for use in front of the cook-stove? There should have been two pieces 6 feet x 9 feet.

"Have fun and I hope to see you on the 27th. Meanwhile, should you need a plane earlier please pass word through Barter Island or Wien, Barrow."

Requests to assist other groups in many ways were continually arising and always were granted if feasible and if they could be granted without undue hindrance to regular ARL projects. The above samples could be expanded many times for any given interval.

About mid-September 1958, while the DARL was not at Barrow, the whole Air Force-Navy agreement in regard to operating at the camp came up again through the announced intention of Puget Sound and Drake, the AF contractor, to close the old hangar at the airfield in which the small planes were serviced. The DARL returned and held discussions with AF representatives in Anchorage. On October 15 he reported in a long letter to ONR that "Our local politics are good, the hangar is still open, and we are having no troubles although the PS and D 40-hour week and AAC directives are exerting some pressure on us."

Near the end of November, Dr. Britton of the Geography Branch, ONR, informed the DARL that ONR was trying to firm up a policy in regard to the operations of the ARL. He named three alternatives---

1. that the existing agreement with AF be continued, 2. that the ARL take over its own vehicle maintenance, or 3. that ARL take over all utilities, operate independently, and bill AF for anything provided. He said that in about two weeks a full Navy meeting was scheduled, that it would include the DNPR, and a representative of CNO, and that a firm Navy position would be decided.

By mid-January the CNR, RADM Bennett had sent two proposals to the AF (1 and 2 above) and ONR was awaiting AF reaction.

The many and varied problems of administration, planning, budgeting, and negotiation kept arising, as is always the case, during the interval covered by this chapter. To illustrate the scope and complexity of some of them, in addition to other specific items that have been mentioned and others that will be discussed later, a few are singled out for brief mention below.

1. The operational contract in the final stages of negotiation with the University of Alaska was broadened, because ONR in Washington was able to find a little additional financing, to include a technician who would be available to assist projects as needed. This and other improvements were designed to increase the service to investigators and thus make more efficient the research.

2. The use of a Jamesway hut at Barter Island was arranged with the AF and it was hoped its use could be made permanent.

3. Additional instruments and supplies were continually being acquired.
4. In the summer of 1958 the ARL launch Ivik was renovated even though plans were afoot to acquire a new and larger boat.
5. The DARL was working with a naval architect in Seattle in regard to the design of an appropriate craft.
6. The greenhouse was enclosed at the ARL during the 1958 summer season.

The attitude and planning of the DARL is apparent from the following quotation from a letter he wrote to Dr. Britton on October 15, 1958.

"I was very well pleased with the progress made by the Laboratory staff during my absence. The greenhouse was completely enclosed, the new vehicles stored in the hospital tents, the lumber stacked on the dock, the back of the animal house was cleaned up, two new dark rooms were walled in, and all the investigators' returning freight, except for two boxes waiting GBL's shipped. We are now busy building the cold laboratory on the south end of Building 250. It will house two large reefers (like the big one outside the old shop) and provide sufficient cold room for Peyton's testing equipment as well as that of any other project engaged in running physical tests under controlled cold temperatures. We removed the back shed to make room for this addition which will open directly into Pitelka's old lab . . ."

In mid-January 1959, the DARL got around to asking official ONR approval for some changes that already had been made. These included the greenhouse, estimated to have cost \$7000 and the cold laboratory, estimate \$10,000. About the same time he reviewed for Dr. Britton the rather comfortable position that the ARL was in, in regard to equipment on hand. This was particularly fortunate because the anticipated funds were expected to be more limited than usual. Dr. Britton replied promptly and also was pleased with the equipment situation especially in regard to transportation equipment but urged caution and careful use of the equipment to make it last as long as possible. He said---

"Now that things are in good condition, with track-laying vehicles, the possession of two aircraft, two helicopters to be delivered, and a Greenland Cruiser under construction, we must make every effort to keep them that way. We must jealously guard not only the aforementioned, but also all heavy duty equipment such as cats, cranes, cherrypickers, oil rigs and the like."

During the first few months of 1959 the old struggle went on between the ARL, or rather ONR, and the Alaskan Air Command over management for service and equipment at the Navy camp. Much of the problem lay in maintenance and repair of vehicles but many other matters were involved also such as buildings, wiring, and plumbing. The DARL felt that he could demonstrate that, if vehicles were repaired for the ARL by Puget Sound

and Drake (the AAC contractor) at Barrow under a reimbursable arrangement, the cost would be up to three times as much as by the arrangement that was in existence and which the AAC wished to change.

The essence of the situation was summed up by the DARL in a letter to Britton dated February 16, 1958. He said—

" . . . our living under any agreement will always demand 'gentle pressure' and a business-like attitude from this office or the contractors and Air Force will run over us. The only change in the past two and one-half years is that this time the semi-annual discussions on support reached the Washington level. Our policy remains 'sweet reasonableness' but with a big stick in the corner in view of all concerned. The stick is continued Navy ownership of the Camp with permit only to the Air Force."

Also during the winter, the ARL was able to pick up from the Air Force a considerable amount of supplies that were declared surplus at Barrow. The principal supplies were items of clothing, mostly new, that formerly were held by PS and D and which were needed badly by the ARL for almost immediate use.

At the request of the Alaskan Air Command, the DARL on March 14, 1959 informed the Command of the support needed from the AF contractor for the fiscal year 1960. The estimated support is summarized below as an indication of the scope and extent of the ARL operation—

Winter

Messing Requirement - Average of 30 staff and investigators and seven native employees who are provided lunch only

Vehicle Maintenance - 6 weasels
 4 jeeps
 3 muskeg tractors
 3 trucks
 1 earth auger
 1 D-8 tractor
 1 D-2 tractor
 1 LVT
 1 cherry-picker
 1 generator

Facilities - Complete electrical maintenance of all ARL buildings
 Plumbing maintenance of all buildings
 Heating units for all buildings
 Heat, power, water distribution, waste disposal, fuel distribution, street maintenance, snow removal, laundry, dry cleaning, hangar facilities, heated equipment storage

Spring

Messing Requirement - Average of 60 staff and investigators plus native employees

Vehicle Maintenance - 9 weasels
 8 jeeps
 5 trucks
 2 muskeg tractors
 1 D-8 tractor
 1 D-2 tractor
 1 cherry-picker
 1 LVT
 2 power boats
 1 generator

Facilities - (Same as for winter)

Other

- Overhaul plumbing and electrical wiring in building 248
- Overhaul plumbing and wiring in two family huts
- Re-wire building 355
- Provide plumbing and wiring in two laboratories

One of the little problems that came up with the AF was in regard to family quarters F2 and F3. In April it was learned that the AF planned to convert those two sets of quarters into a BOQ for AF officers. The ONR pointed out that quarters should not be modified for different use without Navy permission and at the same time requested the DNPR to revoke the Air Force permit to those quarters and reassign them to the ARL.

An interesting development around the end of May 1959 was whether or not it might be desirable to ask for a withdrawal from entry of a parcel of public land around the Lake Peters camp. The DARL suggested a request for withdrawal of about 30 acres that would include the buildings. He pointed out that the area would be for research purposes and that co-operation in research would be by the ONR, the AFCRC, and the Geological Survey.

By early July 1959 the field season was in full swing. The DARL summarized some of the activities in a letter to Dr. Britton on July 6. He pointed out that 43 people were in the field away from Barrow on June 30 and that the aircraft were each flying about 40 hours to 50 hours a week. Both aircraft had had to go to Fairbanks for radio and other repairs. The new boat was operating out of Nome. Kenny Toovak was the skipper of the new boat and Frankie Appik of the old Ivik. Most of the electrical work

had been completed for the ARL by PS and D. ARL personnel had suffered two injuries. One researcher in the field was burned and had to be taken to Fairbanks for a few days for treatment. A workman was ruptured by heavy lifting while doing construction work at Peters Lake. The inshore ice was rough at Barrow and threatened the camp. He concluded—"Other than the above, life goes pretty much as in past years."

At the end of September Brewer reported officially that the special fund of a little more than \$140,000 for procurement of transportation had been expended for 1. construction and instrumentation of a Greenland Cruiser (about \$70,000); 2. purchase of two Cessna 180 aircraft (about \$50,000); and 3. special equipment.

At the end of the field season, about mid-October, the DARL was in a bit of a tangle with one of the field researchers. He wrote to the man involved—

"I was put in a bad bind this year when ONR asked me if I had authorized the wives in the Pass (Anaktuvuk Pass) this summer. Not only did I have to say that I had not authorized it but had to admit that I knew nothing about it. To be quite candid, ONR doesn't appreciate deals like that nor do they help provide for continued support."

The man replied in part---

"Inasmuch as Anaktuvuk Pass is a scheduled stop on the Wien agenda and is visited by not a few tourists during the summer, who come to see

the pass and the Eskimo village, I did not realize that it was necessary to obtain permission from ONR for them to make such a trip."

Specific attention should be directed to the acquisition in the interval covered by this chapter of a power boat for the ARL of the Greenland Cruiser type. The naval architect selected was William Garden of Seattle, and he was notified of his selection in June 1958. The actual purchase was by the University of Alaska under its operational contract with the ONR. By October the main features of the design had been pretty well decided. The DARL reported to Dr. Britton in December 1958 that he had had a discussion with Mr. Garden in Seattle and that all were pleased with the design. By mid-January 1959 he was discussing detailed design modifications in correspondence with Garden.

The construction contract was with the Vic Frank Boat Company, also of Seattle. Early in February 1959 Garden was able to report—"The boat is set up now and gives us an idea of her eventual appearance. Visitors to the yard are extremely impressed with the rugged construction." By February 21 construction was well along.

At the end of April the DARL reported to the ONR representative in Baltimore that the craft should be completed by May 10 and suggested three alternatives for getting the boat to Barrow—1. via the North Star supply ship to Nome and then launch it and run oceanographic studies as it works its way to Barrow; 2. via an MSTs ship to Dutch Harbor and then

under its own power and carrying on oceanographic work to Barrow; and

3. via the first DEW Line resupply ship directly to Barrow. The first alternative was selected. Frank Talbert and Kenneth Toovak of the ARL staff accepted delivery of the Natchik in Nome on June 23. The informal name means "ring seal" in Eskimo. Dr. Ernest Patty, the President of the University of Alaska; local officials; and the Queen of Nome's Midnight Sun Festival inspected the craft before it put to sea on trial runs. The Natchik finally arrived at Barrow on August 22 after a rough passage from Nome.

The two new Cessna 180 aircraft mentioned in the previous chapter were delivered in July 1958 and immediately put to use. Robert J. Fischer, pilot for the ARL, appeared on the roster of the ARL in June 1958. Something of the importance of the ARL airplanes is implicit in a paragraph quoted from the ARL progress report for August—

"Thirty-two days flying were furnished to ARL groups in August, Fischer flew nearly all the flights although a few were charters from Wien Airlines. Field parties were supplied and returned to Barrow late in the month, caribou tissues were obtained and rushed back to Barrow for Dr. Fisher, the Cambridge Air Force people were assisted with flying on those occasions when the pilot was in their area, and both ARL planes assisted in air searches for three lost planes whenever possible. In the latter instance, the ARL float plane returned the two men from one of

the lost planes to Barrow; the ARL wheel plane found and returned the two men lost on a second plane which crashed near Oumalik. Both ARL planes were due for 100-hour checks at the end of the month."

Pilot Fischer was sent out early in November to attend the Army Helicopter School in Texas for about three months. By March 1959 a second pilot had been added to the staff, Robert A. Main, and flying was started out onto the ocean ice in support of an oceanographic project. By early July 1959, the DARL was informing ONR, Washington, that he was going to request at least two more light aircraft. One he wanted especially so it could be fitted for vertical aerial photography and the second in order to make possible two teams of planes for oceanographic work from the ice.

By September arrangements had been made to acquire four Cessna 195 aircraft from surplus and to have them modified for ARL use. The acquisition of helicopters also was underway by that time. The first helicopter arrived at Ladd Air Force Base in Fairbanks in December, but was stored there for the advent of warmer weather in the Barrow area.

In January 1960 the two Cessna 180's were flown to Nome and St. Lawrence Island for reconnaissance work for the icebreaker USS Staten Island. These light aircraft were very effective for such work especially at seasons during which there is little light in the Arctic. In February they again were used in the ocean, mostly in support of projects on Ice Island T-3 and on oceanographic work. During that month the temperature

averaged -8° F, wind east at 15 MPH, and 53 percent overcast. Extremes were $+32^{\circ}$ F and -32° F, wind at 45 MPH, 14 clear days, and 6 days of blowing snow. In March a third pilot, Lloyd W. Zimmerman, was added to the staff and the two 180's were flown 103 hours. Pilot Main ferried the first and badly needed Cessna 195 from Madison, Wisconsin, to Barrow in April. The second 195 reached Barrow in May; it was equipped for aerial photography through a hatch in the floor.

As has been mentioned previously, the matter of supplying family housing at the ARL always posed something of a problem. As the operation became more stable and apparently was to go on indefinitely, the policy gradually was liberalized. Also a few more family quarters were becoming available from time to time.

In June 1958, in reference to a particular request for assignment of family quarters, the DARL pointed out that a few women in camp make life much more pleasant and keep the men from letting their appearance become too seedy. He also noted that allowing wives in some instances enables the ARL to get men to stay longer on critical projects. Another aspect was the desirability of permitting married investigators to live in the village of Barrow—about four miles away. The Director pointed out some of the special problems in that respect such as—how to handle commissary privileges and transportation between the village and the ARL. In a few special cases, investigators were permitted to live in the village.

It was reaffirmed that in general the principle of wives having to be employed would be followed and that each case would be decided specifically on its merits by the DARL and by ONR.

Early in August 1958 ONR and ARL learned that it might be possible to acquire on a loan basis two helicopters from the Army Transportation Corps. This was pursued and a request made. Meantime ARL pilot Robert Fischer was scheduled to take training to qualify as a helicopter pilot. By late January 1959, while Fischer was in training at Camp Walters, Texas, it was learned that the helicopters were not in condition for use without extensive repair, that spare parts might not be available, and the cost of getting them to Alaska would be high. It was decided to scrub the whole idea of the two Cessna helicopters, although the requirement for helicopters at the ARL was still recognized.

By May, however, it was decided to reopen the matter, and two helicopters were obtained and arrangements were made by November for the Air Force to fly them to Ladd AFB in Fairbanks. One of them arrived at Ladd on December 7, 1959.

A careful review of positions, duties, and salaries of ARL staff employees was made in November 1958 and salaries were brought into better balance between positions as well as being generally adjusted upward to bring them a little more into line with other salaries in the Barrow area. In general ARL fringe benefits seemed relatively good, salaries relatively low, but working conditions more desirable.

Toward the end of October 1958 the Office of Naval Petroleum Reserves sent Hugh Saltsman, who had spent a great deal of time at Barrow during the Pet 4 operation, back to Barrow with two assistants to organize and inventory the equipment and materials still there in order to prepare them for public sale. The men from ONPR were furnished billeting, transportation, and other help by the ARL. Mr. Saltsman's work was complicated by cold, darkness, and inexperienced help and by the confusion that resulted from missing records, raids on the stocks since the Pet 4 closed, and by the shifting of much of the material from one place to another. Finally, however, with ARL help, the job was completed. Some items not needed by the ARL were returned to ONPR for sale, other items were transferred to ARL by ONPR, including some buildings, supplies and equipment at Umiat.

The Umiat situation needs a little elaboration. The old oil exploration camp was abandoned except for the emergency airfield and a man or two to handle communications. The FAA had requested a land withdrawal to include the camp, buildings, airfield, at least three oil wells, and other items. The ARL requested a good many items, as well as guaranteed access to the whole area, for possible future use and to prevent them being irretrievably transferred to another agency or into private hands. At least one oil operator also wanted whatever he could obtain at Umiat. The ARL finally acquired most of the items wanted, but it took nearly a year from the fall of 1958 to the fall of 1959.

The help furnished by the ARL to outside individuals and to other groups resulted from time to time in messages of appreciation or of commendation to M. C. Brewer, the DARL, or to some of his staff. For example:

1. By letter of November 25, 1958 J. E. Schroeder, Senior Project Engineer of the Naval Engineering Laboratory at Port Hueneme, California, commended Assistant DARL Paul Tietjen for his help and contribution to the success of the project when Schroeder was at the ARL.

2. The CO of the Fleet Weather Central at Kodiak by message of January 5, 1959 thanked both Brewer and Tietjen for help rendered a Navy ice reconnaissance group. He said "your efforts . . . contributed . . . strongly to the successful conclusion of this program."

3. RADM H. C. Daniel, Hydrographer of the Navy, by letter dated January 15, 1959 also expressed his appreciation to the DARL and his staff for help to the Navy ice observers.

4. Frank Akpik and Edward Hopson, two of the Eskimo staff of the ARL, were commended by personal letters from the Project Officer of Drift Station Bravo for exceptional services they performed while loaned by the ARL to the station. Among other things the letter to Akpik said—"During the period while the mechanical ice drill was broken down you personally drilled five holes through sea ice twelve and eighteen feet thick with a hand auger. The above was accomplished under extremely

adverse weather and light conditions, 'Chill factor V' obtaining during the entirety of the operation with 'whiteouts' occurring twice."

As early as February 1959 a good deal of discussion was going on in both Air Force and Navy circles about the establishment of a new floating station on the Arctic Ocean to replace the former Station Alpha. Apparently there was a general understanding that the cost would be defrayed by both the Air Force and the Navy, but there was some doubt as to which would be the responsible operator. By mid-February the DARL had a plan worked out but it did not go that way. The Air Force became the operating agency, and somewhat to ONR's bafflement, then had to turn to the ARL for all sorts of support to make the station operable. One of the first services provided was the use of the ARL's Cessnas and pilots to scout the ice for the choice of a site. The DARL also became an ice observer from a P2V. One letter of March 31, 1959 to the DARL expressed well ONR's frustration—

"It grieves me greatly to see the way things are going and I greatly dislike predicting how the AAC would freewheel the operation and still have to sit by and watch them do it. They spend the money lavishly without asking and then hand you the bill for it. It is ironic indeed for the AF to run the show and then turn right around and have to have funds, planes, manpower, huts, equipment, etc. from the Navy. What are they doing we could not have done without them?"

Eventually the DARL found himself with the responsibility of picking the site of the new station. On April 15, 1959, he wired Dr. Britton in

Washington---

"Ice floe at 74 degrees, 50 minutes and 159 degree 50 minutes occupied 1200 AST on 14th. Cessna's with Brewer and Smith landed on 13th and returned. Cessna's on 14th landed six AF personnel and C-47 landed 6 AF personnel plus Bennington, Toovak, and Brewer. Floe approximates 25 square miles. Cessnas at Barrow and C-47 at Ladd for emergency needs until strip prepared. C-124's air dropping." Thus Station Charlie became a fact.

On April 27, 1959 the DARL informed ONR that the two Eskimos from the ARL staff had been returned from Station Charlie. He said---

"At that time the Station had 3000 feet of runway cleared and five Jamesway huts constructed. . .

"The Air Force had some very complimentary things to say about Kenny's and Harry's work and I feel that I proved my point about using men experienced in working under arctic conditions be they white or Native.

"The three experienced AF operators cleared 150 feet of runway in the first 18 hours (6 hours per man), Kenny then cleared almost 200 feet during the next six hours and actually cleared about 2000 feet of the 3000 feet cleared. Captain Smith ordered the other operators to follow Kenny's procedures. We do not approve of clearing, feeling the strip should be dragged. However, as long as orders were to clear it, Kenny wanted to do it fast.

"Harry did most of the construction work on the five Jamesways even though he had to straighten all the nails as they were bent when the parachute failed to open and they free-fell.

"Harry worked 152 hours and Kenny worked 155 hours in the 11 days they were on the ice."

Dr. Britton was able to inform the DARL on May 21 that his office would control the scientific personnel going to Charlie. LCOL Joseph M. Quashnock of the AF Arctic Aeromedical Laboratory was designated to control the traffic going to Charlie. On June 5 eight scientific personnel went to the station.

MGEN C. F. Necrason, Commander, Alaskan Air Command, sent an official letter of appreciation on July 13 to the Chief of Naval Operations citing the help of ARL personnel in setting up Station Charlie. He specifically credited the DARL, Pilots Fischer and Main, and Kenny Toovak and Harry Brower.

By July 10, Charlie had drifted to 77.6° N. latitude, 160.4° W. longitude. But by January 1960 Charlie was in trouble—one end of the runway broke off, and the Air Force began to plan for evacuation. Dr. Britton from ONR and the DARL went to Charlie in the hope of finding a way to keep at least a minimum program going. But it was of no avail—additional cracking of the floe made evacuation necessary and personnel and equipment were taken out through Barrow.

Meanwhile, in late 1959 and early 1960, much help was being given to projects on AF Station Bravo on Fletcher's Ice Island, frequently known as T-3. For example, from March 15 to May 15, 1960, several seismic profiles were shot over the continental shelf of the Arctic Ocean. Recording was done at Station Bravo and shot points were occupied by weasel traverse and light aircraft from the ARL.

By April there was talk of, and some preparation for, an ARL ice station—probably to be called ARLIS (for Arctic Research Laboratory Ice Station). Meanwhile T-3 had floated into shallow water and finally grounded. After several frustrating delays in trying to get an ARLIS established, the idea was given up for the time being because the melt season was too far advanced.

As always during the two years of operation reviewed in this chapter, field projects were continually presenting special problems of infinite variety that somehow had to be solved. One case in point, a researcher who planned to return to the John River area in the summer of 1959 wanted to use kayaks on the river. This did not appeal to Brewer and he said so. He pointed out that pilots who had flown the river said that no one should use small boats in the upper reaches because of rocks and very swift water. The DARL indicated that in any event a low-level air reconnaissance of the river would have to be made first and that he would insist on having an Eskimo accompany the party. Another case was the preparation of a

substantial camp on Peters Lake, far east of Barrow, also in the summer of 1959. The AFCRL and the Geological Survey also were interested in that camp. In addition to encouraging some researchers to use the facility, Dr. Britton pointed out that ONR looked forward to limnological research in the two large lakes in the area—Peters and Schrader—and careful thought must be given to appropriate facilities.

During the early spring of 1959 the plans for an elaborate research program in the Cape Thompson area in connection with Project Chariot were coming to a head. Project Chariot was the proposal to excavate a harbor near Cape Thompson by nuclear explosions and its consideration necessitated detailed information in many research disciplines. The DARL and Britton both were anxious that the background and experience of the ARL and its researchers be used as effectively as possible. Over the years some of the ARL projects had extended to within fifty miles of Cape Thompson.

In October 1959 the ARL was host to a group sponsored by ONR which reviewed the ARL facilities and the program. The group consisted of 26 scientists and administrators and represented such organizations as the University of Washington, the ONR, the NEL, BUSHIPS, the Office of the Under Secretary of the Navy, the AFCRL, the AINA, USNUSL, BUDOCKS, the Office of the CNO, Com 17, ONPR, University of Southern California, the Geological Survey, the Canadian Joint Staff, and the Weather Bureau.

Many experienced arctic hands were aboard. The flight arrived at the ARL on October 13. Both Station Charlie and Station Bravo were visited, and the VIP aircraft left on the 16th.

A good idea of the way the costs of the operation of ARL were running is given by a letter from W. B. Girkin, ONR Resident Representative in Baltimore, to Dr. Britton and dated October 5, 1959. It contained the following information for the period July 1, 1958 through June 30, 1959.

Salaries	\$101,471
Overhead	21,848
Travel and per diem	11,324
Freight	7,893
Messing and billeting	46,614
Supplies	18,548
Equipment	133,241
Miscellaneous	12,993
Total	<hr/> \$353,932

Late in 1959 and early in 1960 a good deal of correspondence between ONR in Washington and the ARL discussed two possible land withdrawals for the use of the ARL. One was at Barrow and was planned to aggregate about 5000 acres. The plan was to include the buildings and various other spots of interest and use to the Laboratory. Such items were considered as access to a nearby salt-water lagoon used as a seaplane landing area,

the fresh-water lake used for camp water, the gas wells and perhaps even the whole gas structure, a corridor for the gas line from the wells to the camp, and access to the beach. In February, 1960 the District Public Works Officer of the 17th Naval District visited the DARL in connection with the planning for the proposed withdrawal.

The other possible withdrawal was in the area of Peters Lake already mentioned.

THE RESEARCH PROGRAM IN 1959

Changes in Program Planning

Changes in the organization of the machinery for planning a research program for the ARL followed the reassessment of tasks and procedures after the report of the review group in October 1957. In June 1958 the Arctic Research Laboratory Subcommittee of the AINA Research Committee was formally abolished. That meant that the AINA Research Committee itself took on the review and advisory role previously performed by the subcommittee. Organizational changes within the DOD had also broadened the base of contributions to the planning phase of the arctic research program. Closer ties between ONR and the Arctic Institute planning and review functions were worked out. For example, research proposals which AINA, for budgetary reasons, could not support were now turned over to ONR to be considered for direct ONR financial support.

Three proposals of that type were transmitted to ONR by Robert Faylor for AINA on November 24, 1958. The list of AINA approved projects for 1959 was submitted to ONR on December 19, 1958. Earlier correspondence had resulted in the ONR elimination of nine proposed research projects.

The Program

The AINA-proposed program for 1959 included eleven projects at an estimated total contract cost of \$66,435. That program was accepted by ONR. Subsequently three additional projects were approved for inclusion in the program.

The 1959 research pursued under ONR-AINA auspices included the following projects, of which eight were continuations from the 1958 program and one was a return after a year's absence.

Keith Hussey from Iowa State College continued his project of Geologic and Geomorphic Investigations of the Point Barrow area through field work conducted by Ronald Michelson and John O'Sullivan. Charles Carson of the same team spent part of his time on an Oriented Lake Study, taking cores which were analyzed at the ARL. The Hussey team's field work included a joint effort with John Koranda, from Royal Shanks' team, in studying micro-relief features associated with pingoes.

William Maher of the University of California was at Point Barrow and on the north slope during the summer continuing his field studies of the ecology of pomarine jaegers.

Frank Pitelka's team returned for another season's study of the Ecology of Lemmings, a long standing project, to which Maher's jaeger project was related. In 1959 the Pitelka group again included Thomas Cade, Henry Childs, and Arnold Schultz, as well as Rex Piper, all from the University of California. The 1959 microtine field studies ranged far afield, including the Umiat and Colville River areas.

Marshall Schalk, of Smith College, together with James Hume continued his beach and shore-line profile studies and did extensive work in the neighborhood of Point Lay.

Royal Shanks, assisted by John Koranda, both from the University of Tennessee, also were active in their field studies of tundra vegetation. Part of their time was spent working on records and reports at the University of Alaska. Most of the summer was spent in the field away from Barrow.

John Tedrow led the return of his group from Rutgers to continue his project of several seasons studying soil patterns and in related pedologic investigations in areas near and away from Barrow. In 1959 the group included again Jerry Brown and Lowell Douglas, and added Fioenzo Balloni.

John Campbell, after a year's absence, led a Yale University group, including Thomas Fallingstad and Nicholas Gubser, back to the Anaktuvuk Pass area for resumption of his archaeological reconnaissance. Campbell's field work was interrupted for two weeks on account of an accident with a kerosene stove resulting in second degree burns.

Another ONR-AINA project was that of Timothy Myres, an Englishman at the University of British Columbia, who visited several areas, including the Colville delta, in his study of the Behavior of Eider Ducks. He was assisted by Mike Daniel.

Alton K. Fisher and his group from the State University of Iowa continued work on the project begun in 1958 on the Oxygen Consumption of Tissues, in this case, seal tissues. Unfavorable ice conditions in 1958 had prevented the completion of the project on seal tissues. During the 1959 season Fisher and his assistants, Douglas de Shazer, Victor Walters, and Stanley Wise, extended the study to include also the tissues of lemmings, mice, ground squirrels, whales, and walrus.

During the season Otto Geist of the University of Alaska initiated a study of the extensive Pleistocene vertebrate deposits in northern Alaska. Specimens were collected mainly from the upper Ikpikpuk River. These were brought to the ARL for sorting and later shipment to the University. Geist was assisted by Lewis Aiken, Corey Flinthoff, Eldor Schallock, and Paul Sellman.

Another new project was that of John Sater of AINA, Washington, whose aerial sea-ice photography aimed to develop Photogrammetric and Photo-interpretive Techniques for evaluating the surface morphology of sea ice. He arrived at the ARL toward the end of April and found that the photography would require a modification of the Cessna 180 aircraft to

permit the installation of a vertical aerial camera. Despite this problem he succeeded in collecting much valuable information, both from the surface and by aerial photography.

A new project, headed by Stephen Porter of Yale University, arrived in June to conduct field mapping of Pleistocene geology in the Anaktuvuk Pass area. Since Campbell was conducting archaeological researches in the same area and a party of Shell Oil geologists were working down-valley, a considerable amount of cooperative effort resulted. Porter was assisted by Edward Hall and Kenneth Perry.

Another new project under G. W. Prescott of Michigan State University was begun in the late summer. Prescott's assistant, Harold Howard, remained through the fall to continue the investigations involved in the Limnological and Biological Survey of Arctic Lakes in the Point Barrow Area. In point of fact, the field studies went far beyond the lakes in the Barrow area. Also visited were lakes in the Wainwright, Cape Simpson, Beechey Point, Umiat, Anaktuvuk Pass and other areas reached from the ARL. Biological and chemical samples were analyzed in this most fruitful study.

Finally, a project of botanical investigation, particularly of bell flowers, was operating out of the ARL, beginning in July. The two investigators were Stanwyn G. Shettler and Karl J. Stone, both of the University of Michigan. Their findings were generally negative, but one species was found by Stone.

The 1959 program was an expansion of the 1958 efforts, particularly in the physical-science fields. In addition to the projects enumerated above, there were 21 other projects mainly supported by Government agencies. Four of them were biological. These included an investigation by Richard Swade, of Princeton University, into the Activity Habits of Arctic Animals which was concerned mainly with observation of ground-squirrel activity.

In October, Roger Lewis of the University of Southern California arrived at the ARL to carry on studies of marine biology, conducted from Ice Island T-3. This was done under an ONR contract with John Mohr also of USC, who had earlier carried on research at the ARL.

In April, the Alaska Cooperative Wildlife Research Unit sent Jerry Vogelsang to northern Alaska to take a bear census (polar bears being the focus of interest).

The additional biological research at ARL in the summer of 1959 was carried on by Lloyd Spetzman, who came there as a member of a Geological Survey team headed by Charles Lewis. The team surveyed an area of the coastal plain south of Barter Island. Spetzman collected about a dozen varieties of rare arctic-slope plants.

Several long-standing projects were continued in 1959, such as Allan Beal's Sea Valley and Tide Studies and the Arctic Ice and Permafrost research which Max Brewer had long supervised. During 1959 Beal was

assisted by David French and Donald Stephens. The ice and permafrost work was carried on by Phil Sovalik until September, when A. H. Lachenbruch of the Geological Survey arrived at Point Barrow.

Continued also were the research studies of the IGY Aurora and Earth Potential by the Geophysical Institute of the University of Alaska. The research team included Chris Elvey, Arthur Franzke, Victor Hessler, Tom Baumgartner, and Donald Dyer.

During 1959 also the IGY magnetic observatory was operated by the Coast and Geodetic Survey. The geomagnetic project which had operated under Ralph Barela in 1958 was under the direction of Ardo Meyer. He was assisted by Fred Lampe.

The heat-budget and radiation measurements, which C. Norman Hicks of the NEL had initiated, were continued for a time by Donald Stephens of the Beal team, but were discontinued in April because of equipment failures.

Auroral propagation-studies were continued by the National Bureau of Standards under the local direction of Harry Petrie. The station was operated throughout the year. Mr. Petrie was succeeded by Wes Koch in August. They were assisted by John Workman, George Leavitt, and William Wilson. Al Mitz arrived in November to carry on a "polar fading experiment" for a month.

The study of the Structural and Mechanical Properties of Ice which Harold Peyton of the University of Alaska had carried on in 1958 were

continued. Assisting him were Patricia Peyton and Stephen Nathanson, who was joined by Karen Nathanson in August.

Kurt Toman's project, sponsored by the AFCRC, to study the effects of the aurora on the propagation of radio waves in the 55 to 110 megacycle range were continued also, with changing personnel. Among those at ARL were Ted Barrett, Kenneth Boats, George Bartness, David Pratt, and John Ames.

During the first months of 1959 Hans Bengaard of NBS, who had been a member of Harry Petrie's team in 1958, conducted an ionospheric-soundings program, assisted by Abe Simmons. In July Alton Crawley arrived to take over direction of the project.

Robert Starr from the Navy Hydrographic Office, who had been with George Shumway's group carrying on oceanographic studies in 1958, returned to the ARL in July. He and Nicholas Mabrey, also of the HO, were concerned with the special problem of icebreaker oceanography, and used ARL as a staging area for two weeks in July.

As previously noted, a new project in the study of Sea Ice Micro-meteorology had been initiated in December 1958, with the arrival of a group from the University of Washington on a study headed by Phil Church. The project actually began in early 1959 and continued throughout the year. Among the University of Washington staff who participated were Laurence Lyons, Ken Bennington, Yoest Businger, Robert Ditzler, Donald Makela,

Austin Post, RADM C. W. Thomas, John Kelley, and Mike Miyake. The project required extensive instrumentation. It became one of the principal research efforts conducted out of the ARL.

One of the areas of research interest pursued vigorously in 1959 was ice. In January the first contingent from the NCEL arrived and began preparations for research on a project in Ice Construction Techniques. The aim was to construct or form new ice which would then be tested for strength and other pertinent characteristics. The initial team, which was under the direction of Earl Moser, consisted of Grover Coppedge, Robert Hansen, Sox Lair, and James Schroeder. That group was joined in February by James Dykins, Arnold Funai, Dale Johnson, and L. R. Woodford. Work continued through February and March, and the group departed April 9. No final conclusions were drawn from the different flooding techniques used. Ideal weather conditions had contributed to a successful operation and a mass of information was acquired.

Another ice project was conducted by the AFCRC team headed by Mel Adams assisted by Harold Foley and David French. The group was at the ARL for most of March conducting tests of different means of producing sea-water ice of lower salinity. The variables were the time cycles for "water-on-time for ice formation and the water-off-time for cooling the ice". Several different time cycles were used.

On October 24 two men from the Hydrographic Office arrived at ARL for the purpose of conducting sea-ice observations. An overall

picture of the local ice situation was plotted daily. Aerial ice-reconnaissance flights also were made daily, weather permitting. The project was carried out by David Moore and James Stone under the leadership of Walter Wittmann who was not himself at the ARL.

On April 27 another project was initiated at the camp at Peters Lake. The first team, from the GS, the AFCRC, and ONR was headed by G. W. Holmes. He departed May 9, and Frank Riddell then took over as camp manager. Other persons participating in the project were David Barnes, Frank Leavitt, John Hobbie, PVT Carroll Rock and field assistants Ellsworth Clark, Edmund Mueller, and David Moore. The purpose was primarily to study the strength of melting ice. In that connection limnological studies also were carried out, primarily by John Hobbie, assisted by David Moore. Tom Cade of Frank Pitelka's group and Jerry Brown of Tedrow's party also were at the Lake Peters camp pursuing ornithological and soil classification studies, respectively. The camp was closed in late August.

A geological mapping project under the direction of Charles Lewis of the Geological Survey began operations in early June in the area between Lake Schrader and the arctic coast. Other members of the party were geologist Livingston Chase and biologist Lloyd Spetzman, both of the GS. Large alluvial fan deposits from the Sadlerochit Mountains, but no glacial deposits, were found east of the Sadlerochit River. The

area mapped included other features, including marine deposits and evidence of pingo development. The Kongakut alluvial plain was mapped in July and the Canning River area in early August.

On September 7 Irwin Schenk, from the University of Giessen, Germany arrived at the ARL for the purpose of investigating Arctic Coastal Geomorphology. During his one month in the ARL area he visited numerous areas along the northern Alaska coast and on into Canada. His interests related to the development of ice wedges, polygons, and pingoes. He also was interested in land forms and their reactions during freeze-up of the active layer. He continued on to Fairbanks on October 7 to carry on further work on permafrost.

Ray Vincent of the Stanford Research Institute directed a project titled Backscatter of High Frequency Radio Waves from Land, Sea and Ice. Other members of his group, which arrived at the ARL on November 14, were Donald Alves, V. D. Cone, Phillip Gray, Louis Rorden, Karl Scott, and Burrass Smith. The investigation of backscatter characteristics of different types of arctic land, sea, and ice areas was carried out by use of a PBY aircraft equipped with 32.8 MC radar. Differences were found, for example, between permanent ice and new ice and between the sea-land border and both land and sea. The field project was concluded within two weeks and the SRI party returned to California.

Richard Shoup, from the Geophysical Institute of the University of Alaska, planned and installed a radio-transmission station at ARL.

Summary of 1959 Research Program

All-in-all 1959 was an outstanding year for the research program. A total of 39 projects were pursued, including 14 in the ONR-AINA category, and the number of researchers reached a figure of near 160. The several projects in the biological field, such as those of Pitelka, Maher, Shanks, Myres, Fisher, Shetler, Swade, Mohr, and Prescott, made substantial progress in most cases. More characteristic of the 1959 research program, however, was the greater number of projects in the physical sciences field. They related, of course, to the IGY program in part, in fields of geomagnetism, aurora and airglow, glaciology, oceanography, and gravimetry. Much of the work had been spurred by the findings of the study team of late 1957 and the aroused interest of the Air Force and other government agencies in such fields as ice morphology, oceanography, communications, and other physical phenomena. The contribution of the ice station on T-3 (Station Bravo) was worthy of note in connection with heat-budget research, as well as in the general field of oceanography. The ARL was rapidly expanding its research operations on a broadened base of investigation into a greater variety of fields and a greater refinement and sophistication of much of the research conducted.

In a summary statement prepared in ONR, the accomplishments of the 1959 program were summarized in terms of numbers and substance. It was pointed out that the ARL had grown steadily; that in all 400 scientists

and technicians had contributed, representing 23 government agencies and 46 educational and private research institutions.

Substantively, the statement summarized:

"Accomplishments both on land and at sea include systematic analyses of environments important to all man's activities. Rapid strides have been made on the geography of arctic areas, including coordinated studies of geology, lithology, pedology, meteorology, micrometeorology, and plant, animal and human ecology. Gratifying amounts of data have resulted in considerable insight into the physical and biological parameters controlling the origin, preservation, degradation and engineering manipulation of permafrost. Within the Arctic Basin modest but significant advances have been made in studies of chemical and physical properties of sea-water, bathymetry, sea-level and tidal fluctuations, marine biology, underwater sound transmission, sedimentary history, and currents. Numerous data have accrued on the complex environmental parameters related to formation, deformation, drift, dissipation and break-up of sea ice which contribute to improved ice forecasting techniques.

"Communication and navigation systems have benefitted greatly through investigations of aurora, galactic noise, earth currents, and fluctuations of the earth's magnetic field. Additional investigations in which notable accomplishments have been made include geomorphic processes which shape shorelines and the inshore sea bottom; mechanisms

of deterioration and fouling of structures in coastal waters; sky illuminance and visibility; effects of environment on physiological processes of man and animals; insects and other animals as vectors of disease; microorganisms as agents of disease, deterioration, food spoilage and water contamination; sea ice thickening and strengthening techniques; and cold-weather engineering tests of equipment."

The summary rather slights the details of the many researches in the biological and the few in the social field. The summary is, nevertheless, an impressive survey of accomplishments.

THE RESEARCH PROGRAM IN 1960

Plans for the 1960 program and subsequent research at the ARL were summarized in an unsigned ONR paper at the end of the 1959 season. The paper stated:

"History and accomplishments of the arctic program indicate the research approach to be sound. Future programs are, therefore, planned to proceed along present lines, but more intensively and extensively. Major emphasis, both for the immediate and long range planning, is the augmentation of physical science research especially directed toward the Arctic Seas. The Arctic Basin, both important and little known, constitutes the most urgent research requirement. Present planning provides the essential logistic build-up of the ARL to permit expansion of programs on drifting stations as well as an extensive program of the SKI JUMP-type

activities providing temporary stations by plane landings on the ice pack. Close coordination will be continued with appropriate ONR Codes, Naval Electronics Laboratory, Navy Underwater Sound Laboratory, the Hydrographic Office, and other agencies and offices engaged in common research objectives."

The ONR-AINA research program for 1960 was, as before, the result of informal and formal procedures which led to selection of projects and the allocation of funds. In a letter to Director Brewer dated April 14, 1960, Britton of ONR listed the approved AINA projects for the year. The eight continuing projects included the following:

1. Geist, O., Pleistocene Paleontology
2. Hussey, K. M., Geologic-Geomorphic Relationships Near Point Barrow
3. Maher, W. J., Study of the Ecology and Behavior of the Pomarine Jaeger Population in the Barrow Area
4. Pitelka, F. A., Study of the Comparative Ecology of Lemmings and other Microtines in Northern Alaska
5. Porter, S. C., Pleistocene Geology of Anaktuvuk Pass
6. Prescott, G. W., Limnological and Biological Survey of Arctic Lakes
7. Sater, John, An Evaluation of the Surface Morphology of Sea Ice
8. Tedrow, J. C. F., Study of the Pedologic Processes Operating in the Arctic Areas of Alaska

The new ONR-AINA projects were the following:

1. Chance, N. A., Effects of Winter Conditions on Eskimos

2. Dugdale, R. C. , Sources of Phosphorous and Nitrogen for Lakes
3. Gubser, N. J. , Comparative Study of Nunamiut Eskimo Intellectual Culture (logistic support only)
4. Hobbie, J. E. , Factors Affecting the Primary Production of an Arctic Lake
5. Hulten, E. , Field Study of Arctic Flora
6. Hume, J. D. , Sediment Transportation in the Barrow Area
7. Lowrie, D. C. Spider Distribution in North Alaska
8. Reed, E. , Geology in the Sadlerochit and Shublik Mountains
9. Steere, W. C. , Critical Field Study and Evaluation of Arctic American Mosses

One of the projects (Lowrie) was later dropped, so that the program totaled sixteen projects of which half were new. The researchers were not all new to the ARL, however. Norman Chance, for example, had pursued a different project on Barter Island in 1958. The above-mentioned projects were almost evenly divided between the physical and biological fields, with two in the social sciences. During the season, AINA also managed a field camp at Lake Peters for the convenience of the several projects that were operating in that area. Vincent Peabody was in charge.

The year was one of considerable expansion of arctic research conducted by numerous government agencies or sponsored by them. Such projects totaled about 45 (depending on how many projects the Phil Church group is credited with) and engaged personnel approached the 150 mark.

The character of the 1960 program perhaps can be best understood by indicating the major fields of investigation for all projects operating with ARL assistance and support. The tendency toward continued and expanded emphasis in certain areas of research became apparent.

ICE BECOMES A FAVORED RESEARCH SUBJECT

Approximately a fourth of the 1960 projects at the ARL (14) concerned ice—sea or lake, but mostly sea. Some were broader in scope but were partially concerned with ice, such as the Arctic Ice and Permafrost project which Brewer supervised, but for which Arthur Lachenbruch of the Geological Survey had become the Principal Investigator. That project, therefore, was a continuation of several years research. Another continued project in 1960 was the Ice Construction Techniques study which had operated in 1959 under Earl Moser. In 1960 the project leader was Justin Dykins. He was assisted by a changing crew, which by the end of the year had included twenty different men.

Other continued ice projects included the Ocean Freeze-up Studies under the direction of Walter Wittmann of the Navy Hydrographic Office. The on-the-spot observations were made by Jack Woods and Richard Homa during the fall freeze-up season. Two other projects continued from 1959 were John Sater's sea-ice photography project and the University of Alaska project under Harold Peyton, on the Structural and Mechanical

Properties of Ice. He again was assisted by the two Nathansons and also by Chia Yuan, from the University.

During February a new ice-drilling technique, using a special chemical compound, was the subject of experiment by Beaumont Buck. The project was ONR-sponsored and was conducted at Station Bravo on T-3.

On September 17 a group from SIPRE arrived at the ARL for the purpose of conducting experiments and tests in Ice Engineering. This involved distributed-load tests of different types and under differing conditions of temperature, salinity, and other factors. The project was headed by Dr. Andrew Assur, assisted by four men.

Ice studies were continued or initiated during 1960 by a group operating under the leadership of Phil Church of the University of Washington. Among the several "projects" carried on at Barrow or on the ice stations (T-3 and ARLIS I) were the basic study of Sea Ice Micrometeorology, and studies of Sea Ice Crystallography. The crystallization studies were conducted mainly by Charles Knight and Kenneth Bennington. The micrometeorological research involved a larger group. At some time during the year fifteen men from the University of Washington were involved in the projects at the ARL.

Lastly, included in the ice-study group mention should be made of an MIT group under W. D. Kingery which, during the early part of the year, conducted experiments at Point Barrow in Ice Construction or, more descriptively, Construction on Top of Ice. That project, of course, was

very important to construction work on ice-floes or on an ice island.

Dr. Kingery was assisted by David French, Vincent Larka and David Wiswall. John Hobbie's work at Lake Peters also involved some lake-ice analysis. In an enclosure to a letter to Dr. W. O. Field of the American Geographical Society on December 18, 1960, Max Brewer, in listing ice and glaciology studies at ARL in 1960, included an Investigation of Sea Ice Properties by NCEL. That study was not listed in any 1960 Progress Reports.

Other Projects in the Physical Sciences

Research in oceanography had continued attention in 1960, but the program was not yet extensive.

George Brayton from the University of Washington arrived at the ARL on May 5 to work on Arctic Oceanographic Data under a project headed by Dr. Clifford Barnes. He used equipment that had come off Station Charlie, as well as some shipped from Seattle. The field work included salinity, temperature, BT, O_2 , and current-sampling and observation. Nine stations were established through the ice in the vicinity of Eluitkak Pass into Elson Lagoon. Mrs. Brayton assisted.

The long-standing project under M. Allan Beal, of the Scripps Institution was continued in 1960. He was assisted by the two Shermans and Donald Stephens of Scripps and also was aided by Charles Griswold and Charles Richardson of the Navy Electronics Laboratory.

Related to those two oceanographic projects were the ocean freeze-up observations of the Hydrographic Office and a project headed by James D. Hume of Tufts University involving a study of Sedimentation and Transportation of Shallow Water Sediments in the Barrow Area. That project was of major interest as a shore-line study involving sea action. Hume was assisted by George Denton and by Patricia Hume.

At least 19 projects in 1960 were concerned with atmospheric, electronic, or magnetic phenomena. Several of them were continuing projects.

Among them were the development and operation of the ARL radio station under Richard Shoup of the University of Alaska Geophysical Institute. The crucial importance of radio communications with the ice stations Charlie, T-3, and, in the fall, ARLIS I, placed great emphasis on this activity. The Geophysical Institute's Aurora and Earth Potential project under Dr. C. E. Elvey also continued with Thomas Baumgartner as the local researcher. Dr. Victor Hessler's research on Magnetism and Earth Potential was another continuing Geophysical Institute project. The magnetometer station was set up on ARLIS I in December. Dr. Knight, of the Church group, continued readings after Hessler's departure on December 14. The magnetic observatory of the C & GS was operated during 1960 by Willie Jacobs and later by Ardo X. Meyer.

The National Bureau of Standards continued its Auroral Propagation Studies throughout the year. Dr. Wesley Koch, who had taken over from

Harry Petrie in 1959, was in charge. He was assisted by John Workman, George Leavitt, William Wilson, and Al Mitz. The latter, who arrived in November, also carried on a Pulse Fading experiment.

Another NBS project on ionospheric research was continued under the direction of Alton Crawley, assisted again by Rita Crawley and Abe Simmonds. Similarly, the VHF Auroral Radio Propagation study was continued in 1960 under Dr. Kurt Toman, of Stanford University. The local research was carried on by George Burtness, David Pratt, and James Hodges, all from the AFCRL in Massachusetts.

One of Church's activities was called an Aerial Albedo Study of light conditions in clouds. It was performed by Arnold M. Hanson. Another concerned with Observation of the Infra Red, was carried on by Wallace Murcray from the Geophysical Institute of the University of Alaska.

Another project, a study of Arctic Environmental Optics, carried out by the Navy Electronics Laboratory was supervised by John Hood. He was assisted by Donald Stephens from Allan Beal's group. Astronomic Observations were undertaken in another C & GS project which was performed by Donald Tibbitt, assisted by Ralph Miller and Floyd Stewart. Communications also became the object of local study by a group of seven men from the Navy. The project leader was William Sheets.

During April 1960 Hessler was in residence at the ARL checking the earth-current equipment and refurbishing the field installations.

Recordings continued to be monitored by Baumgartner.

The Naval Ordnance Laboratory sent a team to ARL under the direction of William Schwendinger to carry on Geomagnetic Observations in Northern Waters. The party arrived in July and proceeded to set up a monitoring station at Point Barrow in order to study swell, wind-wave pressure, and variations of the earth's magnetic field on the ocean bottom. Additional information of interest to the NOL oceanographer also was collected.

The year also witnessed the beginnings of research at the ARL under the guidance of Ned Ostenso from the University of Wisconsin. His first project, Gravity and Magnetic Measurements off the Arctic Coast of Alaska, was aided by Robert Iverson and Robert Patnaude. Of the thirty-four sea stations set up, eight were on T-3, and were for gravity observations. No aeromagnetic data were obtained during the April-May project period. Another regional gravity survey was carried out in 1960 by David F. Barnes of the Geological Survey. He was assisted by Rex Allen.

One of the 1960 projects titled Radiation Engineering Studies was carried on by the Naval Civil Engineering Laboratory under L. K. Donovan. The project was concerned with decontamination. A seminar talk on the subject was given by Donovan on April 27.

Another effort in the field of communications interest was the Oblique Incidence Experiment, a National Bureau of Standards project

under Lowell Tveten. The project was successful in finding a way to correct tracking errors between the transmitter and the receiver, according to a report by the investigator in April.

Another project, perhaps more pertinent to the field of oceanography, was initiated in 1960 with the beginning of ice-station work under Dr. Kenneth Hunkins of Lamont Geological Observatory of Columbia University. His project was titled Seismic Refraction Study, and it opened up an area of research which was to be continued in later years under his direction. He was assisted in 1960 by Henry Kutschale. The 1960 recordings were done at Station Bravo on T-3.

As mentioned above, the Arctic Ice and Permafrost investigations were continued in 1960. Keith Hussey's Oriented Lake Study also was active during June, July, and August. Charles Carson assisted Dr. Hussey. Six lake basins were mapped, currents measured, and other observations made by injecting dye in the melted ice water in several small lakes.

The group of geologists at Yale University, under Dr. Richard F. Flint, who had earlier supervised the ill-fated MacVicar party at Chandler Lake, returned to the field in 1960 to map the Pleistocene Geology of Anaktuvuk Pass. The group was led by Stephen Porter, with Garrett Brass and John Livingston assisting. Dr. Flint visited the project during August.

In 1960 also a Japanese team from Meiji University was resident at the ARL for a short time in May and June to record details regarding the geography of the Barrow area, including Barrow village and the local tundra. Professor M. Watanabe was in charge of the three-man party which included Teruzo Kaji and Takash Matsuda.

Another geological investigation of 1960 was the project of Bruce Reed of Harvard University to investigate the Bedrock Geology of Lake Peters. Reed was assisted by Pete Workum. He was concerned with a petrographic study, following up a problem earlier suggested by George Gryc of the Geological Survey. He worked out of the Lake Peters camp operated by the AINA.

One of the "off-shoot" projects from the University of Washington group under Phil Church was the Carbon Dioxide Study planned by John Kelley at the end of December. No investigation was actually started in 1960.

Another project which, though a chemical study, was also of direct concern to biologists, was the study by Dr. Richard Dugdale and Dale Toetz from the University of Pittsburgh of Nitrogen Fixation in Arctic Waters. The purpose of the study was "to ascertain the rates of N fixation by algae, the species of algae fixing N, and the limiting factors of such natural fixation. Water was taken from several lakes and from marine waters. Fifty-one units were completed during July and August.

During September a team from NCEL under Norman Pierce arrived at the ARL to construct two experimental buildings, one of which had been used at the Squaw Valley Olympics. The ARL shop force assisted with the construction. The buildings became numbers 254 and 354.

Another experimental operation was undertaken during August by Captain E. A. Rodgers and a team of ten men of the Naval Air Development Unit. The tests involved use of the newly developed Skyhook--Aerotriever System, designed by Robert Fulton, Jr. The system is a means of retrieving personnel or supplies from inaccessible locations. Essentially, the system depends on helium inflation of a balloon to raise the person or object from the surface to the aircraft. Several successful pickups were reported, and Captain Rodgers called the test series "highly successful" for a "promising system".

Research in Biological Fields

Fourteen studies were primarily biological, and one other had biological as well as social aspects. Eight of the fourteen projects were sponsored by the Arctic Institute of North America. Five of them were continuations: namely, the Pitelka research on lemmings and other microtines; Prescott's study of the limnology of arctic lakes; Tedrow's project on pedologic processes; Maher's study of the population dynamics of pomarine jaegers; and John Hobbie's study of the productivity factors of an arctic lake, in that case, Lake Peters. Essentially, continuations also

were Mohr's work on the ecology of arctic crustaceans and on other aspects of marine biology.

A new study in 1960 was undertaken under AINA auspices by Dr. Eric Hultén of the Riksmuseum in Stockholm, Sweden. Dr. Hultén had conducted studies of arctic flora in other areas and was interested in a comparative study of the flora on the Alaskan north slope. He was assisted by Karl Stone of the ARL.

Another AINA project was that of Dr. Otto Geist, of the University of Alaska, who conducted Arctic Paleontological Studies. He was assisted by Thomas Hamilton and Gilbert Thomson. Collections of fossils were mainly in the Meade River area. They were prepared and then sent on to the University.

Thomas Cade, from Syracuse University, spent nearly a month (May-June) at the Lake Peters station carrying on his studies of Integrative Mechanisms in Predatory Birds. The bird studied was the northern shrike. It was studied through the complete cycle of rearing of the young. Four nesting shrikes were taken into captivity. The study also included other predatory birds and general observations were made of avian and mammalian species at Lake Peters.

Another 1960 project, related to the Pitelka and other ecological studies, was another University of California project headed by Dr. Arnold Schultz, who was assisted by Rex Pieper, Keith Van Cleve, Donald Wellen

and C. C. Delwiche. The study was concerned with the Productivity and Nutrient Cycles in the Soil-Vegetation-Animal Systems of Arctic Tundra. Plots were set up in different areas and were kept under observation, vegetation clipped, and animal disturbances noted. Chemical analyses for nitrogen were made by Van Cleve.

A study of arctic mosses was started in 1960 under an AINA project directed by Dr. William C. Steere of the New York Botanical Garden. He was assisted by his wife and also by Dr. Kjeld Holmen of the University of Copenhagen and Dr. Olov Mårtensson, of the University of Uppsala. The Scandinavian scientists had a rich background of experience in arctic field investigations, and the project proved to be most productive.

Another project in the biological field was that of Robert Rausch of the Arctic Health Research Center in Anchorage. He conducted a study of rabies in arctic foxes. This was a continuation of his work in the general field of zoonoses.

Lastly, the Alaska Department of Fish and Game sent Robert Weeden and Howard Kantner to the north slope to carry on a study of the Ecology of Ptarmigan and Black Brant in that area. They received logistic support from the ARL.

Social Science Research

Although the social-science projects were greatly outnumbered by the physical-science and biological-science investigations, there were four

studies concerning the Eskimos in the former category. One was actually a biological study which would have social implications.

Another of the projects was a Comparative Study of Nunamiut Eskimo Culture and was conducted by Nicholas Gubser of Yale University. His reliance on the ARL was for logistic support only. His study of a Brooks Range Eskimo group concerned "the elements of the environment in the Brooks Range relevant to Nunamiut life, including topography or physical features of the land, fauna, flora, climate, and mineral resources." Mr. Gubser lived with the group, ate their food, and tried to pick up their language. In return, he supplied them with some prized luxury food—items such as tea and milk. His was a summer project.

A second Eskimo study, also part of the AINA group of projects, was carried on by Norman Chance, of Harvard University, who returned to Barter Island to study Environmental Adjustments of Barter Island Eskimos. Dr. Chance arrived at the ARL on March 24. As he stated—

"A major goal of this one month field study was to develop a health survey instrument that would provide a broad epidemiological over-view of the physical and mental health of the Eskimos living at Barter Island." Major attention also was devoted to continuing his study of the effects of rapid change on the Barter Island Eskimos.

A third Eskimo study project was carried on by a group from the Japanese Meiji University. The group was headed by Dr. Masao Oka, who

was assisted by Teruzo Kaji, E. Katayanagi, Tadohiko Matsuda, Takao Sofue, and M. Tagoki. The group arrived in late June and departed a week later for Kotzebue to continue their anthropological and geographical researches. The Eskimos in Barrow village had been the object of their ARL stay.

In addition to the above outlined social studies, a Study of Thermal Balance in Eskimos and Caucasians was conducted by a group from the Arctic Aeromedical Laboratory. The group was led by Dr. Fred Milan, who was assisted by Dr. M. Blair, Dr. Benjamin Covine, Dr. John Hanson, and Mr. David Young. The comparative study, conducted at the ARL, involved seven Eskimos from Barrow and a group of five Caucasians. The experiment involved immersion in water at 33° and 35° C., and measurements of various reactions. The Eskimos lost more heat and showed "less peripheral vasoconstriction". The study was essentially biological, but the findings were also of social significance.

Summary of the Program

The 1960 ARL program was the most extensive and largest up to that year. In all, there were 62 research projects using ARL facilities and/or logistic support. The ARL Monthly Progress Reports listed 207 "investigators" as involved in the projects, and only a few of them, some principal investigators, did not show up at Point Barrow.

The program in 1960 was rather heavily weighted toward the physical sciences, as compared with earlier years. Approximately three projects out of four (44 in all) were in that area. The interest displayed in the ice and glaciology fields, as well as in aurora and magnetism, was notable. The representation of U. S. Government agencies was expanded. Of interest, also, was the representation of foreign researchers from Japan, Denmark, and Sweden.

The year 1960 saw the drawing to a close of the IGY ice-island research and the beginning of a more ambitious program of ice-station activity. Preparations for the setting up of a new ice-floe station were made in the spring, and Arlis I was occupied in September. Station Bravo on T-3 was continued. An increasing number of projects were shaping up for execution at the ice stations. The year witnessed the beginnings of ARL projects under Ned Ostenso from the University of Wisconsin and Kenneth Hunkins of Lamont Geological Observatory. These were to become continuing projects. In 1960 also the University of Washington group, under Church, was much expanded and increased its varied activities. Dr. Bennington of that group became the station leader on Arlis I.

The research accomplished, both in pure science projects and in others of a more practical engineering or applied nature, was impressive. The groundwork also was laid for later projects as well as continuations of ongoing 1960 research.

EXPANDED AIR SUPPORT VITAL TO ICE STATIONS

An idea of the size to which the ARL had grown by the early 60's is indicated by the number of staff members. These were listed each month in the monthly reports. In July 1960 there were 24 listed members of the staff. The staff remained at about that level through March 1961 (24 to 27) and then began to rise with the approach of the field season. In April, 32 were listed, 35 in May, and 41 in June. Some of the increase was for staff at ARLIS II and at Lake Peters as is listed below. A few—2 or 3 and occasionally 4—were part-time or temporary and included usually some of the wives of researchers or other staff members. Generally also a few more than one-third were Eskimos from the village a few miles away.

The types of positions also give some indication of the sort of activities that went on. For example, in June 1961 there were—

Director	1
Assistant to Director	1
Administrative Assistant/Property	1
Administrative Assistant/Field Projects	1
Shop Foreman	1
Station Leader/ARLIS II	1
Chief Pilot	1
Pilot	2
Mechanic	1
Mechanic Helper	1
Secretary/Librarian	1
Secretary	1
Clerk Typist	1
Clerk/Secretary	1
Bookkeeper	1

Scientific Technician	2
Scientific Technician/ARLIS II	3
Electronics Technician	1
Storekeeper	1
Expediter	1
Camping and Supplies	1
Cook-Baker/ARLIS II	1
Cook/Lake Peters	1
Camp Hand/Lake Peters	1
Equipment Operator	1
Laborer	4
Laborer/ARLIS II	1
Carpenter	5
Guide and Custodian	1
TOTAL	<u>41</u>

A typical monthly report at the height of a field season also illustrates the scope and some of the complexities of the program. July 1960 was picked arbitrarily as an illustration. That month 34 projects were listed. They were manned by 87 researchers and assistants from 17 universities in the U. S. and abroad and from 10 other organizations like the Geological Survey, the Navy, the Bureau of Standards, the Alaska Department of Fish and Game, the Naval Ordnance Laboratory, and others.

As was normal during the summer field season, the ARL aircraft were kept busy, whenever weather permitted, in support of field projects. In July the two Cessna 180's logged 181 hours and the two Cessna 190's, 88 hours. Twice in that month the ARL, at the request of the Air Force, provided emergency air support to Ice Island T-3 which was grounded 90 miles northwest of Barrow. In the first emergency on July 2 Chief Pilot Fischer, in an ARL Cessna 180, and Frank Gregory, in a Cessna 180

of Wien Alaska Airlines, flew in near zero-zero visibility to T-3 and evacuated an airman so he could visit his critically ill parents as requested by the Red Cross. Again on July 11 Flecher and ARL pilot Zimmerman flew both ARL 140's to T-3 to take out an airman who had been injured in a drilling accident. With them went Dr. Ruth Coffin of the Bureau of Indian Affairs. Both flights were hazardous, as the airstrip at T-3 had been declared unusable on May 22 due to melting. The landings were made on wheels on a hastily scraped area of the island ice.

In September 1960 Flecher and Zimmerman left for New York to ferry to Los Angeles for overhaul a Lodestar aircraft that was being acquired principally for supporting ARL floating station ARLIS I, which was being established and which will be described later. Flecher again participated in a T-3 emergency in October. A geophysicist on T-3 had been badly injured in a TNT explosion. The Assistant DARRL, John Schindler, borrowed the use of a DEW Line aircraft, put Flecher aboard as copilot, and brought the injured man to Barrow.

Flecher and Zimmerman delivered the Lodestar to the ARL in mid-November and after a little practice in the Barrow area, drops were made at ARLIS I on November 20 and 26. The Cessna's also were used in support of ARLIS I. February 1961 was a typical winter month for air support of ARL. The following quotation from the report for February illustrates the sort of air-support activity that was almost routine —

"In spite of the cold temperatures during the month, the ARL Cessnas were flown a total of twenty-four hours, in twelve trips, in the support of projects at Anaktuvuk Pass, ARLIS I, Lake Peters, and Pitt Point. Although only one pilot, Fletcher, was in residence during the month, trips were made to ARLIS I on the 16th and 20th. In each case, a local Wren Airline pilot was employed to fly the second Cessna 180. Main and Zimmerman, the other ARL pilots, were in Arizona. Main spent most of the month completing his helicopter training while Zimmerman assisted in the rehabilitation of the R4D aircraft being readied for ARL use. The plane was about ready to come north at the end of the month. Also, during February, the two Cessna 180's were given 100-hour inspections in Fairbanks in preparation for the spring flying program."

March 1961 was a busy time for air activity. The R4D aircraft arrived to make the ARL complement 2 Cessna 180's, 2 Cessna 190's, 1 Lodestar, and 1 R4D. A new administrative assistant/staff pilot, Richard Brent, Jr., joined the staff. For April the hours flown were —

<u>Aircraft</u>	<u>Hours</u>	<u>Number of Flights</u>
Cessna 180's	156 hours	36
Cessna 190's	42 hours	12
Lodestar	3 hours	1
R4D	23 hours	3
	<hr/> 224 hours	<hr/> 52

In June 1961 the priority activity was the establishment of floating station ARLIS II on an ice island. On June 7 the R4D edged off the runway on the ice island on landing and was damaged only slightly, but sufficiently to ground it for the rest of the spring season. The aircraft was pulled back on the runway on June 11, repaired, and flown off the island on June 16—the last aircraft to leave the island for the summer.

Also about that time Main apparently was replaced by Joseph H. Felder. Main's name appears on the roster for May and Felder's for June. One of the Cessna's landed on a river bar on the Nagavakishik River on July 10 with a field party and remained overnight. The river overflowed during the night and completely surrounded the aircraft. The plane could not be returned to the ARL until the following month.

At the end of June Chief Pilot Fletcher received from the Air Force the Exceptional Service Award for his medical emergency flights already mentioned. The award was presented by Major General C. F. McCrason, CO of the Alaskan Air Command, at a full dress review and air salute in Fletcher's honor.

The first landing after the 1961 summer on ARLIS II was made by the ARL R4D on September 18. On November 15 the R4D made a resupply flight to ARLIS II that very nearly turned into a tragedy. The DARL was aboard. At the station the aircraft was refueled for the return flight, and a drum of diesel oil was inadvertently pumped into the tanks along with

several drums of aviation gasoline. About 20 minutes out on the return flight, the engine began to malfunction, but a forced landing was accomplished on a frozen lead about thirty miles southeast of ARLIS II. The landing was made with wheels up because of darkness and poor visibility to prevent the aircraft hanging over. Immediately an emergency camp was established. By 9:45 the next morning the R4D was spotted by an Air Force search aircraft, and on November 17 all men were picked up and returned to Barrow by a C 123 J belonging to the Alaska Air National Guard. On the very next day, the ARLI's seized R4D was delivered to Barrow by Fletcher, and that aircraft, although it was plagued with a great deal of engine trouble, largely took over the servicing of ARLIS II.

On Christmas Eve a supply flight brought to ARLIS II most of the necessities for a Christmas holiday including a tree, turkeys, apples, pears, and even Japanese mandarin oranges. They were put to good use. Flights were scheduled at that time of year at full moon, when visibility was sufficiently good to see pressure ridges on the ocean ice.

During February 1962 cooperation was extended to the Alaskan Air Command by assisting in the search for T-3 that had been abandoned in October 1961. On February 16 the ARL R4D on a supply trip to ARLIS II sighted the ice island about 150 miles northwest of Barrow. The recognizable features such as the runway and the camp seemed to be in good condition. Help also was given the AAC in reoccupying the camp.

R4D 17217 while returning from a supply flight to ARLIS II on March 24 spotted the R4D (19078) that had been abandoned in mid-November 1961. It was about 20 miles from the station on a pressure ridge in an area of broken ice and appeared badly damaged. It was obvious that the aircraft could not be retrieved. On the same flight an abandoned drift station, believed to be a Soviet station, was seen about 200 miles southeast of ARLIS II. On March 28 a Soviet aircraft, probably a TV 114, flew three times over ARLIS II at 500 feet. The aircraft dipped its wings, but made no attempt to land.

By April 1962 the task of getting ready for the summer program was underway. Another pilot, Robert L. Murphy, was added to the staff. That month 59 flights were completed in 24 days for a total of 109 flying hours--93.5 with the R4D and 215.5 with the 4 Cessna's. A good deal of the flying was to help get T-3 ready for occupancy. T-3 was transferred officially by the AAC to the ARL on April 12.

On a flight to ARLIS II in May, a manned Soviet station was noted on a floe about half way to ARLIS. The R4D landed, and there were friendly exchanges of smiles, handshakes, and photographs. The language barrier prevented much communication.

ARLIS I is Established and Abandoned

It was planned to establish an Arctic Research Laboratory Ice Station, to be named ARLIS I, in May 1960, but the plan had to be

postponed because of the difficulty encountered by commercial air carriers in obtaining insurance for their aircraft participating in the establishment and support of the proposed station. The decision then was made, after consultation with the Commander Alcock Sea Frontier at Kodiak to attempt to establish the station in the fall by means of the icebreaker USS Burton Island. The ship, with CDR Griffith C. Evans, Jr. in command, arrived off Point Barrow for summer operations on July 10. During August it made a trip to 1-1 and returned to operate along the north Alaskan coast.

On August 24 a P-4V flight, with the Director and Chief Pilot of the AMI aboard, made a flight from Eielson Air Force Base over the Beaufort Sea to try to locate an appropriate ice floe for the station and to observe ice conditions in order to plan the best approach for the Burton Island. Good floes were seen in the vicinity of the 75°N parallel and between 140° and 150°W longitude. The ice also was more open toward the east, and the observers recommended that the icebreaker skirt the north coast and approach the ice from the vicinity of the northwest coast of Banks Island. At the end of the month COM 17 authorized the attempt.

Between September 1 and 3 the Burton Island loaded sixty tons of supplies and fuel at Barrow and departed on her mission on September 3. She followed the circuitous route planned and entered the pack ice on September 6 at $73^{\circ}-43'\text{N}$ and $126^{\circ}-40'\text{W}$. As the pack became tighter, reconnaissance was accomplished by helicopter and a suitable floe was

entered on September 10 at 76°-09, 6'N and 136°-27'W by the DART, the proposed station leader, and the Executive Officer of the Norton Island, and the ship came alongside that day.

The flue was 6 feet to 8 feet thick and near the station site were two leads that were expected to make good landing sites for equipment and fuel when they froze later in the fall. Unloading and construction of the camp started immediately and around the clock and by the afternoon of September 12 was completed and a flag, procured by USMC Krone, was raised. Aft. 12 was a tent. The camp included a kitchen, mess hall, six laboratories, living quarters, and two generator buildings. The generators were up and running, the radio working, stores were sheltered, and the fuel positioned. The planned fuel was supplemented by 10,600 gallons of diesel pumped from the Norton Island into four large plastic tanks.

The icebreaker cast off and reached Barrow on September 20. Left on the station were:-

Dr. Kenneth Bennington, Ice Physicist and Station Leader

Dr. Charles Knight, Ice Physicist and Assistant Station Leader

George Brayton, Oceanographer

Robert Ditaler, Electronics Technician/Radio Operator

Arnold Hanson, Micrometeorologist

John Tibbs, Marine Biologist

Frank Adpik, Equipment Operator

Because the camp was complete before the Burton Island left, research began almost immediately. Synoptic weather and solar radiation studies started on September 15, physical oceanography and marine biology on September 17, and exercise studies would begin soon.

During October cracking of the ice flow near the station was noticed and began to cause some concern. A new site was selected just to be prepared in case moving became necessary. Also potential survey sites were checked continually. A much appreciated comb was brought in on one of the Cessna's that landed at AMLIB 1 on November 23 as well as fresh produce and scientific equipment that had arrived too late to be put aboard the Burton Island. The station had been ten weeks without resupply. Cracking became more serious near the end of the year. One fracture crossed the runway and passed close to the camp. Another went under a fuel dump, and still another opened nearly six feet between one hut and the kitchen-mess hall. There was no ice within two miles of the camp that could serve as a runway for heavy aircraft, but the Cessna's could still operate in the camp area.

By January it was recognized that the station was in what had become a weak-ice area. Within seventy-five yards of a hut a lead opened to about 50 yards wide and then closed to form a pressure ridge. It was apparent that the station would not be useful in the coming summer, and the decision was made to abandon it. This was done on March 25, 1961.

In its six months of operation it had drifted 615 miles to $74^{\circ}-59'N$, $169^{\circ}-50'W$. It was evacuated by air during a 7-day period. About 24,000 pounds of equipment were removed, leaving a stripped camp.

Kenneth Towrah was in charge of the evacuation, and he and his staff deserve much credit. The monthly report for March contains the following in regard to the task:

"The task of the task encountered by these people is best described by their actions in the last hour and a half on station. The R4D aircraft touched in on the beacon, touched the Camp, and landed on the refrozen lead 1.5 miles away. The OKW Wille generator, used for the beacon, was immediately shut down and the group left for the airplane pulling the generator on a sled behind the wheel. On arrival at the plane, the generator, weighing 2500 pounds was dismantled into three sections and loaded aboard the aircraft. The wheel transmission, a scarce part at Barrow, was removed and with 1700 pounds of other freight, was loaded. The men then climbed aboard, and the plane took off. The entire operation took only ninety minutes, and the R4D kept one engine running the entire time."

ARLIS II is Placed on an Ice Island

Plans and preparations for a second floating station, ARLIS II, were well underway long before ARLIS I was abandoned. By February 1961 eight prefabricated wanigans for the proposed station had been constructed at Barrow. These were all lost in a shop fire that will be described later. A temporary carpenter shop was set up, and by the end of April the twelve

wanigans needed for ARLIS II were nearly completed. John Beck, recently retired Naval Chief Metalsmith, who had a great deal of arctic experience, was selected to be the leader of the new station.

Air scouting for a good ice floe on which to locate ARLIS II was carried out on several days from the 13th to the 22nd of May. On the latter date a tentative location was picked at about 76°N , $158^{\circ}-45'\text{W}$. The next day the R4D and two Cessna's were loaded and took off to make the first landing. At $73^{\circ}-10'\text{N}$, $156^{\circ}-85'\text{W}$ the flight spotted an ice island with many rock hills about 50 feet high. The light aircraft landed and guided in the R4D. An immediate decision was made to place the station on the ice island although it was a little farther south than was considered ideal. The aircraft started to bring supplies and gear to the new station as follows:

May 23	3 flights	12,000 pounds
May 24	2 flights	8,000 pounds
May 25	5 flights	27,000 pounds
May 26	7 flights	41,000 pounds
May 27	3 flights	16,000 pounds
May 28	5 flights	<u>29,000 pounds</u>
TOTAL:		133,000 pounds

By June 5 the camp was ready for scientific equipment. The 13 buildings had been erected. A gravity survey had been completed, and a preliminary map and survey of the ice island had been made. The

crippling of the R4D by running off the runway already has been described. June supply flights had to be by the Cessna aircraft to a total of 35 flights and 21,700 pounds of supplies and equipment. The greatest number of people at ARLIS II overnight in June was seventeen. The summer pig-over crew numbered 15—11 scientific and four support persons.

After the closing of ARLIS II to aircraft for the melt season, the ARL Lodestar made air drops as required. Resupply of ARLIS II was to be by the USS Burton Island. She loaded at Barrow, but some of the loading had to be on the lee side of Point Barrow because of floating ice, and started for ARLIS II at midnight on July 23. Ice conditions were bad, and the ship broke its rudder and had to cancel the rest of the trip. Meanwhile, the ice island had been faring badly also and by the end of the month, about one-third of the island had broken away from the rest.

About July 1 the melting of the island had left the buildings high on ice pedestals, and the buildings had to be moved. All hands helped, and the camp was completely moved on one day. The operation had to be repeated on July 28.

On August 17, 1961 the USS Staten Island (another icebreaker) arrived off Pt. Barrow to substitute for the Burton Island in resupplying ARLIS II. She left the next day, and on the 19th reached the station and started unloading. In the cargo were a D-4 tractor, 2 weasels, a heavy winch for oceanographic work, a hot-water jet, 8 new buildings, lumber,

360 drums of POL, 5000 pounds of explosives, and food stuffs for a total of 125 tons. The ship also pumped an additional 30 drums of fuel to the station from her tanks. The Staten Island then made one more run from Barrow to the station with another 100 tons of freight, mostly POL. She finally departed the station on September 5. The runway was worked on at ARLIS II, freezing proceeded, and on September 18 the station received its first aircraft, the R4D, of the new winter season. At the end of September, 17 people were on station.

The position of the station on October 1, 1961 was $76^{\circ}-36.8'N$, $174^{\circ}-32'W$. On October 30 the location was $76^{\circ}-13.3'N$, $178^{\circ}-30'W$. The total estimated drift in that 30 days was 120 nautical miles. The forcing down of the R4D in November has already been described. Occasionally station personnel were disturbed by polar bears although usually they gave little trouble. Early in November 1961 one of the station personnel was chased in the main camp area. The bear later broke a window in the cook's storeroom and a window in another building. Eventually the bear had to be shot.

On November 15, John Beck, who had been station leader since ARLIS II was established, was relieved by John E. Sater. On April 16, 1962, by careful handling of the winch, a bottom sample was obtained from 1470 fathoms, the deepest sample taken by an American group in the Arctic Ocean. During May and June every effort was made to

deliver as much cargo as possible to the station in anticipation of the termination of landings during the melt season. The last load was landed on June 18. On the first anniversary of ARLIS II, on May 23, the station was more than 600 miles northwest of its starting point.

T-3 Reoccupied

T-3 (Fletcher's Ice Island) had been abandoned by the Air Force in October 1961 at a point about 90 miles northwest of Barrow. In February 1962 the ARL pilots cooperated with the AF in trying to find the island again. On February 16 T-3 was found on an ARLIS II flight at a point about 150 miles from Barrow. The next day a 3-man occupation crew was flown in by light aircraft to set up a minimum establishment, set a homer beacon, and service the equipment. Within a few days three more persons were added and the R4D could land on the partially cleared airstrip. From then on tenancy on T-3 was almost entirely by ARL personnel. On April 12 the Alaskan Air Command officially transferred T-3 on an "as is, where is" basis to the ARL. Soon the station was again ready for research work to begin. In June the buildings new and old, were divided into two camps for safety reasons. The last supply flight to land during the summer of 1962 was on June 13. That flight was an Alaska Air National Guard C-132, and the runway was so soft that the nose ski was badly damaged.

Maintenance and General Activities

Summer field activities were at their peak in July 1960. Field parties were at Lake Peters, Kuparuk River, Pitt Point, Porcupine Lake, Umiat, Bettles, Meade River, Driftwood Creek, Pitmegea River, and Cape Thompson. In the following month general activities increased somewhat with the chores necessary in connection with the wind-up of field projects. During September shop activity was sharply curtailed after the departure of the icebreaker for ARLIS I because three of the shop force were aboard the ship.

Also during September the staff was joined by John F. Schindler, who from then on became a key official of the ARL. That month the ARL was visited by Dr. William R. Wood, the new President of the University of Alaska, who replaced Dr. Ernest N. Patty, who retired. October was "catch-up" month at the ARL for activities that had been deferred because of the summer rush. In the following month Paul Tietjen, for three years the valued Assistant to the DARL, resigned and was officially replaced by John Schindler.

Early in the new year, 1961, the conversion to a recreation room from a garage was started in Building 251, and panels for wanigans to be used on ARLIS II were under construction. On the morning of February 20, Frank Talbert, the Shop Foreman, glanced out of the window of the Coffee Room and saw smoke coming from the shop. Everyone rushed to

help fight the fire but to no avail—the building was a total loss in less than an hour. This was a staggering blow to activities. Lost were all eight pre-fabricated wanigans, all the metal-working and wood-working equipment, all the small tools, a large supply of celotex and plywood, 12 small transformers, and the "nuts and bolts" accumulation of many years. Also lost was a new weasel, just modified for shop use. An hour after the discovery of the fire, new equipment was being ordered by telephone, and arrangements were underway to use the warm-up shed as a temporary shop.

As the days lengthened in March and April, activities increased greatly. The recreation room in Building 251 was completed, ARLIS II wanigans were well underway, the office was enlarged, and much general maintenance was done. In May, 34 projects were underway with 67 investigators. In addition, the Laboratory hosted 30 guests during that month. By June the projects had increased to 45, with 100 investigators. In that month the Lake Peters camp was remodeled and enlarged. About half of the family quarters at the ARL also were remodeled and greatly improved.

During September the last of the outlying field parties were brought in and their gear retrieved. General rehabilitation of the ARL and equipment went on throughout the fall. Many visitors were welcomed at the ARL during the summer and fall. Among others these included Senator

Ernest Gruening, Governor William Egan, and Dr. Werner von Braun. Several organized groups also visited, including one in October of an Arctic Research Review Group sponsored by the Arctic Institute of North America and the Office of Naval Research.

By the end of the year only 16 projects were operating with 29 persons. Many of the staff were on leave. General maintenance continued, and contract personnel arrived to start construction of the new shop building. Vehicles were being overhauled, and warehouses rearranged for more storage and easier removal of items. Such activity went on through February 1962. By March new projects were being started, and 51 investigators and assistants were at work.

Field camps were being prepared in April for the coming summer season and field equipment readied. By June the summer rush was underway. There were 42 projects and 101 investigators. The ARL staff at that time totaled 56, and living accommodations at the ARL were filled to capacity. In that month, for example, the carpenters finished four 14' x 20' wanigans to be attached to the new shop building and two Dravo-heater shelters, each 12' x 15', for the same building. A wanigan was built for the immediate use of the Pitelka project as the first segment of a new animal-house complex. A side of one living hut was remodeled and another started. Pilings were set for 4 shop wanigans.

In July 1960 the engines of the old LCM LIZ MARU were overhauled; the IVIK and the newer NATCHIK were made ready for ocean

work. The ARL dories also were repaired and painted. In August it was reported that the NATCHIK consumed a good deal of staff effort to iron out the "bugs" encountered after the craft had laid on the beach for ten months. Rough water and floating ice also gave trouble, but the boat continued "to be better able to stand the Arctic Ocean when it is rough than do the crews". In 1961 in August and September the IVIK was used principally for carbon-dioxide studies and for a marine-biology project. It also was used to deliver some freight to DEW Line stations along the coast to the southwest.

As has been pointed out previously, it has been the policy consistently to assist other organizations and groups in carrying out research and related projects in all reasonable ways. The ARL has leaned over backwards in adhering to that policy, and as a result many other activities not directly related to the program of the laboratory have benefited substantially. A few examples of the kind of help given in 1961 and 1962 are described briefly below. No attempt is made to make the coverage comprehensive—many projects that were helped have not been included. The ones included, however, do cover a wide range of activities and also a wide range of types and amounts of assistance. Some projects were helped in a minor degree and were more or less incidental. Others were substantial indeed. Most assistance was given without any thought of reimbursement, but in a few cases it was necessary to request some financial assistance or some other form of assistance in kind.

In July of 1960, Dr. Britton of ONR and the DARL visited the AEC project (Project Chariot) at Cape Thompson to familiarize themselves with the program at that site and to arrange for scientists at ARL and at Cape Thompson to use each others' facilities to further their programs. In August of the same year, the ARL assisted the NOL magnetic project by helping construct and plant three concrete anchors, each weighing about a ton, off shore in deep water to reduce the possibility of ice damage. The anchors were lowered from the LCM LIZ MARU with a "cherry picker".

The Fulton Aerial Retriever was given a thorough test in several arctic environments---T-3 representing the ice pack; the USS BURTON ISLAND representative of a ship at sea; Lake Peters as typical of a mountain area; and Meade River as a tundra environment. The ARL advised and assisted in several ways.

One effort of very considerable magnitude was the furnishing of assistance in October 1960 to NCEL in the construction of buildings for personnel quarters and for a shop. Approximately 400 man-hours of staff assistance were provided. NCEL offered to reimburse ARL for the help, but no bill was rendered as ARL felt it would inherit the buildings when NCEL was through with them.

In November 1960 the shop staff completed a field wanigan for the use of the Army's Snow, Ice, and Permafrost Research Establishment

(later CRREL) in an ice-testing project. Also in that month ARL hosted Dr. Roland Wallstedt of the Lawrence Radiation Laboratory who wished to become familiar with the work at ARL in connection with some of the projects at Cape Thompson. In addition two representatives of the contractor at Cape Thompson visited ARL to discuss cold-weather operations.

In the spring of 1961, in April, the ARL obtained for the AEC 120 miles of aerial photography of sea ice near Cape Thompson. In June the ARL received for a visit COL William Nungesser, Commander, CRREL and Dr. James Bender of CRREL in connection with projects at Lake Peters and elsewhere.

The ARL in January 1962 modified a building for the Naval Civil Engineering Laboratory by extending it eight feet and by remodeling and painting the rooms. In June the ARL arranged for Dr. Robert Gerdel of CRREL to visit T-3 to appraise the feasibility of establishing a micrometeorological project there.

THE RESEARCH PROGRAM IN 1961

The 1961 research projects to be supported by the Arctic Institute under its ONR contract were selected by the application, screening, evaluation, and selection method which had operated in roughly the same pattern the year before. The approved projects were made known to Director Max Brewer on March 9 by letter from Max Britton in ONR. Sixteen projects were listed, of which seven were new. Of the sixteen only four were in physical-science fields; ten were in the biological sciences, and two in the social sciences.

The bulk of the 1961 research program was supported by the Navy and other government agencies. The interest in Arctic Basin research remained strong, and projects to be carried on from the drifting stations were proposed from several agencies and institutions. Multiple projects were planned for the University of Washington group of researchers under the direction of Phil Church. A group from the University of Southern California under Dr. John Mohr also planned a multi-project program.

As has been noted, the several projects operating in the Lake Peters area had been served by having a camp operated under AINA auspices during the summer of 1960. Similar plans were made for the summer of 1961, and Frank Riddell again was placed in charge. A half dozen projects were scheduled to work out of the Lake Peters camp. (Steers, Hultén, Cade, Solecki, Reed, and Swade projects).

The 1961 program became a more ambitious one than the previous year's. Some 80 projects of scientific or technical nature were carried out under ARL support arrangements. Nearly half of them (36) were, in effect, continuations of projects from the year before. Twenty-two of the forty-one physical-science projects were repeats. Twelve of the twenty-seven biological science investigations were continued, and an additional two principal investigators of 1960 returned to ARL in 1961 to carry on new programs. In the social-science field, two of the four research projects were continuations.

The Physical Science Program

The physical sciences accounted for half of the 1961 projects. Aurora, magnetism, gravity, and atmospheric subjects were the concern of sixteen projects. Ten of them were continuations from 1960. They included:

1. Auroral Propagation Studies under the National Bureau of Standards, with John Workman as the field worker under Wesley Koch, and later under William Utlant and James Auterman. The work continued for the first eight months of 1961.
2. Earth Current and Magnetic Studies under Dr. Victor Heesler, University of Alaska. This also continued for eight months.
3. Gravity and Magnetic Measurements of the Arctic Basin under Ned Ostenso, aided by Robert Iverson and Richard Wold, also from the

University of Wisconsin. During May and June a group of twelve men from the Naval Air Development Unit also assisted.

4. Geomagnetic Investigations in Northern Waters carried on by William Schwendinger for the Naval Ordnance Laboratory continued throughout the year. He was aided by Philip Dobak and Archie Saunders of NOL, and by Karl Stone, Robert Thompson, and Gary Sides of the ARL.

5. During February and March 1961 Wallace Murcray of the Geophysical Institute continued his studies of Infrared Emission of the Atmosphere on ARLIS L.

6. The National Bureau of Standards continued through the year its Ionospheric Research project under Alton Crawley. He had assistance from his wife, Rita, from Abe Simmonds, George Leavitt, and from Dale Bucham, who arrived in May.

7. Another University of Alaska Geophysical Institute project under Dr. Hessler, namely his Magnetic and Earth Potential Studies, was continued during the first three months of 1961.

8. The Coast and Geodetic Survey continued to operate the Magnetic Observatory on a twelve-month basis, with Willis Jacobs in charge. CDR Philip Weber arrived and departed in April.

9. The Regional Gravity Survey, operated by the Geological Survey, again was active during March, April, August, and September, under the leadership of David Barnes, assisted by Rex Allen and Robert Jachens.

10. The Naval Electronics Laboratory continued through the entire year the Arctic Environmental Optics project, with Donald Stephen at ARL. John Hood was the Principal Investigator.

New projects in these fields during 1961 included the following:

1. A study of Acoustics and VLF Measurements by the Navy Underwater Sound Laboratory, with Guy Harris, and later Dr. Robert Mellen, in charge. The field work was carried on from June through December by Karl Milner.

2. After the ARLIS II began operating in May, one of the projects there was research on Gravity and Magnetism at ARLIS II which was continued for the remainder of the year. Dr. G. P. Woollard from the University of Wisconsin was the Principal Investigator. The ARLIS II work was performed by Stephen Den Hartog, D. Jan Black, and Robert Iverson, all of the University of Wisconsin.

3. Another study, Gravity and Microbarograph—ARLIS II, also was carried on from May into August by LTJG L. LeSchack of ONR and William McComas of the Hydrographic Office.

4. Dr. Woollard had another Gravity Observation project at Barrow during November. The observations were carried on by Barry Carlson and Richard Longfield.

5. Also during 1961 the National Bureau of Standards had two men, Arthur Diede and Francis Honey, at the ARL carrying on during June certain VLF Phase Studies.

6. A U. S. Public Health Service Radiation Measurements project was carried on during October to December by Jay Silhanek, assisted by Otha Whitsett of the ARL.

The field of ice and glaciology continued to be of great interest in 1961 and involved at least a dozen projects. Eight of the projects were continuations from 1960:

1. The Ice and Permafrost project under Lachenbruch was continued.

2. The Ice Engineering project, operated in 1961 by CRREL, under Guenther Frankenstein, was assisted by Thomas Bernard, Lorne Kany, Frederick Kittleberger, Gerald Freese, Thomas Lyons, and John Stokes. The group was at the ARL during September, October, and November.

3. Dr. Church continued his project on Petrofabrics of Sea Ice at ARLIS I and, after April, at Barrow through the researches of Ken Bennington.

4. Another Church project was his Sea Ice Crystallography study at ARLIS I (until it was abandoned), through Dr. Charles Knight.

5, 6. Included were two Sea Ice Micrometeorology studies, one at ARLIS I and later ARLIS II, and a second at Barrow. The drifting-station project was carried on by Arnold Hanson, Charles Cooke (ARLIS II) and Richard Sommerfield. The project at Barrow was performed by

Robert Bergstrom, Kenneth Castek, John Kelley, Franklin Badgley, Charles Robertson, and Sam Antion.

7. Another year-round ice study continued from 1960 was the University of Alaska project under Harold Peyton on Structural and Mechanical Properties of Ice. Again he was assisted by Stephen and Karen Nathanson and Chia Yuan. Lorne Kany of the CRREL group also aided.

8. The study of sea ice by means of photography was continued in 1961 by John Sater from AINA during March and April. Extensive areas from Barter Island, to T-3, to Kotezebue were covered.

Other projects concerned with ice or glaciology research and experimentation were new in 1961.

1. Among these was the Geology and Glaciology study of ARLIS II conducted by Dr. David Smith of Louisiana State University. He was assisted by Charles Knight of Church's group and by Robert Schraeder of the ARL.

2. The Navy Hydrographic Office started in April, and continued for the remainder of the year, a project involving Strain Measurements of Arctic Ice Pack. The project also involved ARLIS II. Dr. Walter Wittmann was the Principal Investigator in charge, but the research was performed by a group which included Thomas Garrett, William McComas, Richard Ketchum, Lindsay Redin, August Battisfore, and Carroll Lassettre.

3. For four days during August a University of Alaska project under Dr. Troy Péwé carried on a Study of Large Scale Contraction-Crack Polygonal Ground on the Point Barrow spit.

4. Finally, toward the end of August, 1961 a group of 13 men from the Naval Ordnance Laboratory moved out to thick old polar ice, through which explosion tests were conducted. The tests were partly to meet operational requirements. The ice-breaker STATEN ISLAND was used. Charles Vogt was in charge of the project.

Oceanographic research was continued in 1961 primarily involving two projects.

1. The Arctic Oceanography project of the University of Washington under Dr. Clifford Barnes was active through the whole year. Investigations were continued on ARLIS I until it was abandoned, then transferred to ARLIS II in June. Work also was accomplished out of Barrow. The field work was done by George Brayton, Perla Brayton, Robert Schraeder (ARL), John Cooper, John Linhart (ARL), and Richard Sommerfield.

2. The Monthly Progress Report for May listed as a separate project one under Phil Church called Oceanography, ARLIS II. It was essentially the same project which was established on ARLIS II by John Cooper and John Linhart. The Arctic Oceanography project was thereafter listed as one of the Church projects.

Geological investigations in 1961 were carried on by both continued and new projects. Dr. Keith Hussey of Iowa State University returned

for two months in order to conduct observations on the Geomorphology of Portions of the Arctic Coastal Plain. Work was carried on in the Sagavanirktok River area, and alluvial fans in the Franklin Bluffs area also were studied. Pits were dug in the upland tundra, and the Hussey group joined Péwé in his ice-wedge studies near Point Barrow.

Bruce Reed of Harvard University also returned in 1961 to the Lake Peters camp and continued his local investigations into the Bedrock Geology of a Portion of the Lake Peters Area. He was assisted by James Fisher in the summer project. A total of 44 days were spent in field work. Approximately 120 square miles were mapped in detail.

During August and September Charles Carson from Iowa State University conducted Geomorphic Investigations of Oriented Lakes of Kuparuk River Region. Pingo Lake and several adjacent basins were examined. "Water temperatures, bottom samples, permafrost profiles, current and wave patterns and geo-morphic position of selected small basins were recorded."

Also during the summer months Dr. Harley Walker, assisted by Herbert Morgan, both of Louisiana State University, conducted field research on the Recent History of the Colville Delta and Analysis of Alluvial Processes. Cross sections were made, samples prepared, photographs taken, and measurements recorded in the course of the field investigations.

The Ice and Permafrost investigations of the Geological Survey under Lachenbruch, as previously mentioned, also were continued during 1961. Much of the 1961 project was concerned with ARLIS II, measuring heat flow beneath the Arctic Ocean. Field work continued at Barrow, and data were obtained also from Alaska highway authorities on readings at Glenallen. Persons contributing to the studies were Thomas Sovalik, James Lewis, Karl Stone, and Theodore Humphrey of the ARL and Gordon Greene of the Geological Survey. Dr. Lachenbruch also spent some time in coordinating efforts with permafrost researches in Canada.

Two seismic studies were operative at the ARL in 1961. The Arctic Basin Acoustical Studies begun by Kenneth Hunkins' Lamont project in 1960 were continued from May to November on ARLIS II. Henry Kutschale again did the field work. Wave propagations, both in ARLIS II ice and ocean bottoms, were studied. Sub-bottom reflection shooting also was carried on.

Land-based seismic studies were carried on also from June to September by a project headed by Dr. Edward Thiel of the University of Minnesota. Dr. Ostenso also consulted on that project, which was titled Refraction and Reflection Seismic Studies on the Arctic Slope. Assistants were Dennis D'Andrea, James Olson, and Karl Veith, also from the University of Minnesota. Use also was made of the STATEN ISLAND for firing shots in the sea, up to a distance of 335 km. from Barrow.

The Carbon Dioxide atmospheric studies in the Barrow area were continued by John Kelley of the Church group throughout 1961. Samples were taken also over the ocean from the IVIK.

Another project resumed in 1961 was the study of Sedimentation and Transportation of Shallow Water Sediments of the Barrow Area by Dr. James Hume of Tufts University. He was assisted by Mrs. Hume and by Geoffrey Smith. The researches in the Barrow area continued from June to September.

Other ARL projects of technical or applied-science nature included a ten-day evaluation of the serviceability under winter conditions of a 20' x 48' dormitory and a 28' x 42' shop building. Mr. James Camm of the Naval Civil Engineering Laboratory conducted the on-the-spot study. Another NCEL project was the installation of a sea-water intake/sewage system. This involved the work of nine men under the direction of William Nehlsen. Work was carried on in April and from August through November.

Another project, called Tee Pee Experiments, was a classified project carried out by ACF Industries under Frank Cassidy assisted by James Turner.

Biological Research

The program in the several areas of biological research was considerably expanded from the 1960 program. For example, there

were 27 projects of this type operating as compared with half that number in 1960. The number of projects may not be a fair comparison, however. The 27 projects in 1961 included six for which Dr. John Mohr was Principal Investigator. Of the 27 projects, 12 were repeaters. In addition, Dr. Rausch returned, but with a new project. Of the 27 projects, 10 were supported by AINA.

The projects may be roughly divided into four groups: a) animals living in water, salt or fresh; b) land animals; c) studies of land flora; and d) miscellaneous biological studies.

The first group included eleven studies. Of those six were directed by Dr. John Mohr of the University of Southern California. He was assisted by eight men, some of whom worked on more than one project. The researches concerned:

1. Arctic Basin Marine Biology—ARLIS I and II. John Tibbs, George Kabacy, and Donald Robinson assisted.
2. Biology of Right, Gray, and White Whales. Dr. Floyd Durham, Larry Headlee, Alec Ibanez, Arthur Markovitz, and George Kabacy assisted.
3. Dynamics of Arctic Lakes. Durham, Ibanez and Kabacy assisted on that one also.
4. Lake Research in Biology—Barrow and Vicinity. Hitoshi Matsudo and Donald Robinson assisted.

5. Marine Biology. Dr. Mohr was assisted by Donald Robinson.

6. Research on Ecology of Crustaceans. Headlee, Markovitz, Durham, and Ibanez assisted.

Two other projects in that group were returns from 1960. Dr. Gerald Prescott returned to continue his study of Limnology of Arctic Lakes, assisted by Victor Gilliland. John Hobbie returned from Indiana to pursue his investigations in a Productivity Study of Lake Peters. He was assisted by Olivann and Charles Hobbie.

New projects in 1961 included another limnology study, specifically of Lake Peters and pertaining particularly to Life Adaptations of Arctic Cladocera. Dr. David Frey, of Indiana University, worked alone on that one during May and June. Also includable in this group was the project Skeletal Analysis of Arctic Fish, carried out by Dr. Melvin Moss of Columbia University during July and August, and a Survey of Whales in the Barrow Area, carried on by Dale Rice of the U. S. Fish and Wildlife Service.

Researches involving land animals included the following six:

1. The continuing study Ecology of Lemmings under Frank Pitelka. He was assisted in 1961 by Dr. Kurt Bohnsack, Lawrence Chamberlain, Richard Holmes, David Mullen, and John O. Sullivan, all of the University of California, and by Karl Stone of the ARL. Research went on from May into September.

2. The continuing study of Integrative Mechanisms in Predatory Birds by Dr. Thomas Cade of Syracuse University.

3. Dr. Robert Rausch, who had previously investigated rabies in arctic foxes, returned in 1961 on a broader study of Animal Borne Diseases (Zoonoses), again coming from the Arctic Health Research Center in Anchorage.

4. A new project by Richard Swade of Princeton University began the study of Entrainment of Biological Clocks to the Arctic Solar Day. He was in the field from April into September. The study involved recordings of animal activity, light, and temperature, and the shipment of animals back to Princeton for continued recordings.

5. A special study of Environmental Adjustments of Arctic Foxes was the purpose of another land-animal investigation by Dr. James Lindzey of the University of Alaska. He was assisted by Dr. Otto Geist, who had his own project in 1960 and 1961, and by David Chesmore.

6. Another one-animal study was done by Dr. William Pruitt, also of the University of Alaska, assisted by Peter Lent. The study was concerned with the Pre-calving Movements of Caribou.

There were five botanical projects. One involved Botanical Photography of Arctic Flora. The project was carried out by Dr. and Mrs. Raymond Wood from the National Museum of Canada.

Dr. John Koranda of the Alaska Agricultural Experiment Station at Palmer conducted Botanical Taxonomic Studies of Arctic Ecotypes,

assisted by Dr. Leslie Klebesadel and Dr. Harlow Hodgson. The field collection was made during July and August.

During June, July, and August Dr. Charles Smiley from Macalester College, St. Paul, made an investigation of the Cretaceous Floras of the Kuk River Area. He was assisted by Howard Scharn, also from Macalester. The party packed 300 pounds of fossils for shipment back to the college.

Two other principal investigators returned in 1961 to continue researches begun in 1960. The projects were Dr. Eric Hultén's Field Study of Certain Groups of Arctic Flora, and Dr. William Steere's Study of Arctic Mosses, in which he was assisted by his wife and again by Dr. Holmen from Copenhagen and Dr. Mårtensson from the University of Uppsala.

In addition to the above biological studies there were six others. Dr. John Tedrow and his colleagues, Ed MacNamara and David Rickert, returned from Rutgers to continue investigation of Pedologic Processes Operating In the Arctic Areas of Alaska. Although the project was not primarily biological, it did become concerned with plant contributions to the soil and was, therefore, not exclusively a study of geology and geography. The study was not too far removed from another project which also was continued, namely, the project of Dr. Arnold Schultz from the University of California.

The Schultz study concerned Productivity and Nutrient Cycles in the Soil-Vegetation-Animal System. Assistants were Rex Pieper, Robert Robertson, Dr. Constance Delwiche, Dr. Hans Jenny and Keith Van Cleave.

Dr. Otto Geist, in addition to assisting Dr. Koranda, continued his own project, Arctic Paleontological Studies.

A group of three, headed by Dr. Charlotte Holmquist from the Zoological Institute of Sweden, operated out of the ARL during July and August searching for Arctic Relatives of Certain Marine Glacial Relicts. Mysids were looked for especially, but other animals were sampled also. Only a few Mysids were found. Holmquist was assisted by Bernice and Ulf Lettevall.

For a month (June 29 - July 29) Dr. G. Edgar Folk from the University of Iowa conducted a study of Twenty-four hour Psychological Rhythms in Arctic Animals. The study was in some respects similar to Dr. Swade's. The Folk project was essentially a psychological and behavioral study. Ground squirrels, snowshoe rabbits, and a fox were used. Dr. Warren Essler and Mary Folk assisted.

A physiological study was conducted during April and May by Dr. Laurence Irving (former Scientific Director of the ARL) and Keith Miller for the Arctic Health Research Center. The study concerned the Reaction of Human Fingers and Skin to Cold. Selected members of the

Eskimo population of Barrow were used for the tests, as well as members of the ARL staff. In all, tests were made on 53 individuals, and results later analyzed.

Research in the Social Sciences

There were only three 1961 projects which could be included in the social sciences. Two of them were returns from 1960. One was the work by Dr. Norman Chance (in 1961 from the University of Oklahoma) on Arctic Studies in Eskimo Culture Change and Mental Health. Much of the field work in 1961 was done by an assistant, Jean Briggs, from the same university, who was able to work with the Eskimo women on Barter Island. Many interesting data, particularly comparative as between the sexes, were gathered.

The 1960 project, Comparative Study of Nunamiut Eskimo Culture, which had been started by Nicholas Gubser of Yale University went on from January into August 1961 as a continuous study. His study became rather broad, covering as he stated, "the fauna, climate, and epistemology of the Nunamiut."

The third project concerned the Archeology and Ecology of Northeastern Alaska and was directed by Dr. Ralph Solecki of Columbia University, Department of Anthropology. He was assisted by Dr. William R. Farrand of the Geology Department of Columbia, who was concerned with the relationship of the archeological sites to glacial deposits. The

other scientists in the party were Jerome Jacobson and Robert Blanchard, graduate students, and Bert Salwen, Research Associate. The purpose of the investigation was to gather evidence on how early man arrived into North America by uncovering archeological remains of early people, who presumably had been funneled through the narrow corridor near the Canadian border between the Brooks Range and the arctic coast. Several sites were discovered ranging back to pre-Eskimo occupation, dating back about 5,000 years. Investigations were carried on in the foothills of the Sadlerochit and Shublik Mountains.

Miscellaneous Projects and Activities

In addition to the scientific projects already described, other activities, at or out of the ARL, went on which were not scientific but were related to the research program.

Two of them were in the photographic field. During June SGT George Woolsey of the U. S. Army, Alaska, spent ten days at the ARL taking a Northern Operations film in color and in black and white. He exposed 3000 feet of film, using as his subjects the ARL offices, laboratories, and operations, and also Barrow village activities.

On September 28, Lowell Thomas, Jr. and William Bacon III arrived from Fairbanks to take general background pictures for a University of Alaska film. Sequences were filmed of several of the projects.

During January Donald Baumgartner and Joe Brabec from the Arctic Aeromedical Laboratory were guests of the ARL while they inspected the progress being made in modifying the oil-flush sanitation system at Barrow. They analyzed problems as being caused by "under-design in the size of the plumbing to the oil fired boiler".

On July 10 Dr. John Durrer and Glenn Stanley from the Arctic Aeromedical Laboratory arrived to carry out the so-called "Sarah" experiments, of unspecified nature. They departed after three days because, as the Monthly Progress Report for July stated, "The extremely tight flying schedule coupled with the bad weather made it impossible to complete this study."

On its return trip from ARLIS II the crew of the STATEN ISLAND detonated seismic charges at regular intervals, to be received by monitoring stations at ARLIS II, T-3, and Barrow.

During October and November ice islands T-3 and ARLIS II were reconnoitered as possible NCEL test sites for year-round ice-platform studies. Melvin Hermann of BUDOCKS and Justin Dykins, NCEL, conducted the survey. They did not land on T-3, which was no longer occupied by the Air Force, and they did not find it suitable. They also concluded that only short-term sea-ice studies would be possible in view of logistical support problems on ARLIS II. They expressed the hope that AFCRL activities offering joint support might materialize.

Summary of the 1961 Program

The seasonal distribution of research at or out of the ARL during 1961 is indicated by the following statistics on total projects and total investigators, month by month:

	Projects	Investigators
January	21	29
February	22	29
March	26	39
April	26	42
May	34	67
June	45	100
July	49	114
August	45	109
September	29	63
October	22	41
November	20	38
December	16	29

During 1961 the ARL Monthly Progress Reports listed a total of 80 projects or investigations. The total personnel involved and present at the ARL during some time of the year was nearly 250. The figures indicate an increase of nearly 20 projects and about 50 investigators over the previous year.

The year 1961 was notable in the successful occupation and use of ARLIS II, after the prudent abandonment of ARLIS I on March 25. ARLIS II was occupied on May 25 and became a major platform for scientific investigations. T-3, which had run aground in 1960 was moving again, had been reoccupied on February 12, and was also a base for 1961 research operations.

The year was a profitable one for an increased group of projects in the biological sciences, including a number of continuing investigations such as those of Pitelka and Tedrow. During 1961 there was also greater evidence of the "umbrella" system whereby one principal investigator, such as Church or Mohr, staged several research projects by the use of a group of researchers, the members of which could be utilized on more than one project. The efforts to coordinate the work of related but separate projects continued. Researchers working out of the Lake Peters camp, for example, were mutually aided and their findings reinforced by colleagues working on separate projects.

The drifting-station investigations were advanced in 1961, but were limited in part by the need to abandon ARLIS I and the over-taxed resupply facilities of the ARL. Nevertheless, progress was made in ice studies, oceanography, micrometeorology, marine biology, and seismic investigations. In total, 1961 was the "biggest" research year ARL had experienced.

Evidence of the increasing public interest in ARL research took the form of filming projects, visits of press people, and others who publicized the Laboratory and its program.

THE RESEARCH PROGRAM IN 1962

The 1962 research program continued the pattern that had been developing of keeping a core of continuing projects to make up about

half the total. The total program was slightly reduced from 1961 and approximated the 1960 program. The number of projects was down from about 80 to 61, and the number of resident researchers dropped from about 250 to about 200. The Arctic Institute-sponsored research again was weighted toward biological projects, while government agencies supplied the bulk of the investigations in the physical sciences. Thirty-four of the 61 projects were continuations.

The magnitude of research operations at the ARL during 1962 may be seen from the following figures:

Research projects and number of investigators by month:

	Projects	Researchers
January	19	32
February	19	30
March	25	51
April	28	55
May	30	63
June	42	101
July	41	101
August	39	120
September	26	65
October	19	48
November	17	25
December	15	22

The concentration on summer research was still heavy, but the number of year-round projects was substantial. The occupation of ARLIS II in May 1961 led to the use of that base for further research in 1962, and reoccupied T-3 was also receiving its share of attention as a base for acoustic and geothermal studies.

The division among the major fields was roughly back to the 1960 pattern. The 1962 distribution was:

Physical-Science Projects	37
Biological-Science Projects	16
Social-Science Projects	7
Other	1
Total	<hr/> 61

As in 1960 and 1961 the program in the physical sciences was dominated by projects of government agencies. Among the agencies involved were the Army (CRREL), the Air Force (AFCRL), and the Navy through the Oceanographic Office, NOL, NEL, NCEL, BUSHIPS, BUDOCKS, and the Underwater Sound Laboratory. Represented also were the Geological Survey, the Coast and Geodetic Survey, and the Atomic Energy Commission. University and college research projects at the ARL included a broad variety of subject matter and represented a total of 21 institutions.

Physical Science Research in 1962

Of the 37 projects in the physical sciences 20 were continuations of earlier projects. They were distributed among the major fields of physical science not greatly different from the two or three previous years.

Gravity and magnetics

Gravity and magnetics accounted for six projects. All of them were continuations. Earth Current Studies were pursued by Dr. Hessler of the University of Alaska. Geomagnetic Investigations in Northern Waters was a Naval Ordnance Laboratory project under William Schwendinger. It was continued during the entire year, with Gary Sides of the ARL and William Nelligar of the NOL doing the field recordings. Gravity and Magnetism Research on ARLIS II was under Dr. George Woollard of the University of Wisconsin. James Pew, D. Jan Black, and William Unger were the field researchers. Gravity and Magnetic Measurements of the Arctic Basin, another University of Wisconsin project under Ned Ostenso, was continued during March, April, and May. Stephen Den Hartog carried on the field measurements. The Magnetic Observatory was in operation throughout the year, with Willis Jacobs of the Coast and Geodetic Survey in charge. He was spelled during October by Willis Osbakken. A Regional Gravity Survey, a Geological Survey project under David Barnes, was continued during March and April by Robert Jachens. A total of 41 gravity stations were established, mostly in the Umiat area, and in the Canning River-Lake Peters area.

Atmospherics and meteorology

Atmospheric and meteorology studies accounted for 8 projects, of

which 3 were continuations. They included the NEL study of Arctic Environmental Optics under John Hood. For that project Richard Mayfield and Donald Stephens collected data from January through July 10. Data analysis was, thereafter, carried on at San Diego. The Barrow site was left open for reactivation. Carbon Dioxide Studies, a University of Washington project under John Kelley, were continued through the year, with an assist from John Unger. Air samples were taken from numerous locations over land, water, and ice throughout the region, including ARLIS II and T-3. Ionospheric Research under Alton Crawley of NBS was also continued through the entire year. Again assistance was given by Rita Crawley, George Leavitt, and John Workman.

Among the new projects was an Aerial Albedo survey conducted by Arnold Hanson of the University of Washington group during flights on July 25 and 26 by an R4D properly instrumented. As part of an auroral program, the Geophysical Institute sent Dr. T. Neil Davis to Barrow in January to conduct All Sky Camera Studies by the installation of an all-sky camera. After Davis' departure the operation of the camera was continued by Donald Stephens, NEL, through a cooperative arrangement. A naval communications team headed by LTJG Ishmail Vaughn arrived at Barrow early in July and installed testing equipment. The project was completed in August. The Oceanographic Office in October sent Donald Gerson and Thomas Garrett to the ARL to install, test, and evaluate a

portable Automatic Weather Station (PAWS). Observations were transmitted and received, reportedly "with good success". In November the station was moved to T-3 and set up on the south side of the island. During June, July and August, the NEL had another group at the ARL conducting VLF studies under the leadership of Charles Norgard. After signals had been monitored and recorded at the ARL, the equipment was moved to Fairbanks. The results of the project were stated to be "very gratifying".

Acoustics and seismology

Acoustic and seismic research continued to receive attention from four continuing and two new projects. Two of them were projects of the Naval Underwater Sound Laboratory under the leadership of Dr. Robert Mellen. The projects involved Acoustic and VLF Measurements, one on ARLIS II and another on T-3.

Dr. Kenneth Hunkins from The Lamont Geological Observatory also had two projects called Arctic Basin Acoustic and Seismic Studies, one on ARLIS II and the other, set up in May, on T-3. The ARLIS II group included Henry Kutschale, Gerald Rasmussen, and David Prentiss. The party of T-3 included James Alberino, Ralph Shaver, James Cottone, Arthur Jakela, and Frank Ambrosio. Extensive data were gathered on acoustics, magnetics, underwater-sound propagation, as well as oceanography and navigation.

The Refraction and Reflection Seismic Studies conducted by Dr. Thiel of the University of Minnesota in 1961 were continued on a reduced and semi-training basis during 1962 under the leadership of Dr. Glenn Bowie, who brought Lance Berglund and James Olson with him from the University for a relatively brief stay in August-September.

The General Motors Defense Research Laboratory began a project of Underwater Acoustic Research in the Arctic Ocean and on ARLIS II. The Navy-sponsored project was led by Beaumont Buck, who was assisted by Walter Brown, Alexander McDonald, Leo Blickley, Arthur Witten, and (in December) Charles Green. That was the beginning of a project of long duration under Buck's leadership.

Snow, ice and oceanography

Studies of snow, ice and oceanography also continued to receive emphasis in the 1962 program with ten projects relating to those subjects.

Dr. Phil Church was not himself involved in the field studies, but his two projects in Sea Ice Micrometeorology were continued on ARLIS II and at Barrow. Paul Dix and Charles Cooke of the ARL staff, assisted on ARLIS II, and Richard Sommerfield, Peter Witt, and Arnold Hanson also were on station there. A group of 10 assistants eventually participated in the Barrow-based project.

Other returning or continuing projects included Dr. Walter Wittmann's study of Strain Measurements of Arctic Pack Ice at ARLIS II. Personnel from the Oceanographic Office included August Battisfore, Carroll Lassettre, Lester Wentz, Kenneth Lackie, and Charles Senior. Another was Harold Peyton's study of the Structural and Mechanical Properties of Ice. Again he was assisted by Patricia Peyton, Lorne Kany, and Karen and Stephen Nathanson.

Among new projects was one on Sea Ice Sampling, conducted by Dr. Marvin Cohn for the Bureau of Ships during November. Another was a project involving Foam Experiments on Pack Ice, a NCEL project under Nancy Slover during the April-June period. Essentially the study involved observation and testing of the effects of surface foam on ice deterioration and ice composition.

During the period March 15 to April 9 a study of Lake Ice Orientation was conducted at Lake Peters and Lake Schrader by Jiro Muguruma and Katsuhiro Kikuchi from Hokkaido University, Japan. It involved observation, measurements, and coring at a time of increasing thickness of lake ice. Thirty pounds of ice were taken back to the University for further study.

During August the Army sent a group of 5 men from CRREL, led by James McLerran, plus 9 from the University of Michigan, to conduct Sea Ice and Arctic Slope Terrain Studies by Aerial Sensing. The

objectives of the project were to "develop a technique of sea ice interpretation" and also of terrain interpretation of infrared and radar imagery from the air. Large areas of sea and land were covered during the 17-day survey.

Another survey project was staged by Dr. Carl Benson of the Geophysical Institute from March through August. It involved a Reconnaissance Snow Survey on the Arctic Slope of Alaska. Donald Coonfield and Emil Peel assisted Benson.

In connection with those studies, mention should be made also of the collection of Oceanographic Data from ARLIS II by Paul Sun of the ARL on behalf of another project connected with Dr. Church. Measurements were taken during the period January to September.

Geology, geomorphology and geography

Three of the seven projects in geology, geomorphology and geography were continuations from 1961. They included Dr. Keith Hussey's project on the Geomorphology of the Arctic Coastal Plain of Alaska. That AINA-supported study was active from March through August. Hussey was not present, but the field work was done by Gary Anderson, Frank Reckendorf, Richard Faas, and John O'Sullivan, all from Iowa State University.

Dr. Harley Walker returned from Louisiana State University to continue (April-September) study of Recent History of the Colville Delta

and an Analysis of Alluvial Processes. His assistants were Dr. Lennart Arnborg, Johan Peippo, and Dr. Herbert Morgan of L. S. U. and Jack Woods of the ARL.

The third project was the study of Sediment Transportation in the Vicinity of Barrow, conducted by Dr. James Hume of Tufts University, also with AINA-administered funds. Dr. Marshall Schalk, who had earlier conducted shoreline studies at Barrow, also returned for a time to assist with the Hume project.

During November and December Arthur Lachenbruch, who had worked earlier with Max Brewer on ice and permafrost investigations, made preparations for undertaking Geothermal Studies on T-3. He had assistance from B. Marshall and R. Kennelly in acquiring equipment and preparing for the Arctic Ocean basin heat-flow study.

In the spring of 1962 Dr. Jerry Brown, who had worked with Dr. Tedrow, returned to Barrow to conduct Frozen Ground Studies near Barrow. He now represented the Army, CRREL, as did his assistant, Robert Lewellen. The research continued into September. His research concerned the active layer.

The Geological Survey supported a summer project led by Charles Lewis, assisted by Harry Dodge, in investigating the Geology of the Arctic Coastal Plain of Northern Alaska. At the same time, the University of Wisconsin team of Thomas Hamilton and Richard Christensen

conducted Geomorphic Investigations in the Central Brooks Range, an AINA project.

Research in the Biological Sciences in 1962

As in earlier years a large segment of the program in biological subjects was arranged through the Arctic Institute. Of the sixteen projects in this group, nine were return studies and, in addition, two principal investigators returned with projects that had at least some aspect of a repeat or continuation.

The returning projects included:

1. Arctic Basin Marine Biology—ARLIS II under Dr. John Mohr.
2. Caribou Investigations, under Peter Lent of the University of Alberta.
3. Daily Physiological Rhythms of Arctic Mammals, under Dr. G. Edgar Folk, Jr., of the University of Iowa.
4. Ecology of Lemmings and other Microtines, under Dr. Frank Pitelka of the University of California.
5. Environmental Adjustments of Arctic Foxes, under Dr. Fred Dean and Dr. Lindzey of the University of Alaska.
6. Integrative Mechanisms in the Pairing of Predatory Birds, under Thomas Cade.
7. Pedologic Processes Operating in Arctic Areas of Alaska, under Dr. John Tedrow of Rutgers University.

8. Photography of North American Arctic Flora, conducted by Dr. Raymond Wood and his wife from the ARL.
9. Productivity and Nutrient Cycles in the Soil-Vegetation-Animal Systems of Arctic Tundra, led by Dr. Arnold Schultz from the University of California.
10. John Koranda returned in 1962 to carry on Arctic Grasses and Legumes Studies.
11. Dr. John Frey of Indiana University returned to study the Primary Productivity of Arctic Ponds.

The above projects were of differing dimensions, ranging from Dr. Cade's solo operation to Dr. Pitelka's field party of six. The Lent, Wood, Koranda, and Frey projects involved two field workers each. Dr. Tedrow did not himself engage in field work in 1962, but had a group of five, including one from the ARL. Dr. Mohr also was absent, and the field work was done by a group of four. The Folk, Dean, and Schultz projects occupied four persons in each case.

New biological-science projects in 1962 included a collection project which the Smithsonian Institution and the Los Angeles County Museum carried out in two visits to the ARL and Umiat. The Collection of Wildlife Habitat Groups involved the taking of a large male, a medium-size female polar bear and a specimen moose, plus two purchased polar bear skins, all of which were given preliminary taxidermy treatment for

shipment to the Los Angeles Museum. Hugh Logan led the separate groups which were in northern Alaska in April and again in September. Five others from the museum assisted him.

Three new projects were included in the Arctic Institute program. One of them was the return to the ARL of Dr. William Maher, from San Francisco State College, to study the Development of Passerine Birds. During June and the first half of July he worked on two aspects: one to determine the nesting density of passerine birds, and the other "to observe the growth rate and development of homeothermy in Lapland Longspur and the Snow Bunting."

A second project involved field study and collection to determine the Distribution and Abundance of Tundra Arthropods. Field work began in June and continued until September. The principal investigator was Dr. Kurt Bohnsack of San Diego State College, assisted by colleagues, Richard Ashley and Gilbert Challet. Classification and counting of arthropods in different areas of northern Alaska, as well as in different types of soil, resulted in a considerable collection of information, as well as specimens to be returned to the college.

A third AINA-sponsored project was a study of Microbial Metabolism and Soil Fertility in Arctic Soils. The investigator was Dr. William L. Boyd of Ohio State University, who had carried on earlier investigations at the ARL on arctic microorganisms during the period 1955-1958. He

was assisted by his wife, Dr. Josephine Boyd, by Dr. Orville Wyss, and by James Staley. Dr. Wyss was from the University of Texas. Field operations began in June, and continued for the remaining summer months. Soil samples were taken from selected sites from Barter Island to Cape Beaufort. Fertility studies were made on chosen plots, and nitrogen fertilizer was utilized to study the effect on certain strains of bacteria which had previously been obtained at McMurdo Sound, Antarctica. In August, a vertical sampling was initiated in cooperation with Dr. Jerry Brown of CRREL. Readings were continued after the tundra became frozen.

Another new project, carried out by Dr. Klaus Schmidt-Koenig of Duke University, was titled Experiments in Avian Orientation. The purpose of the study was "To examine the sun-compass orientational-response of homing pigeons to the midnight sun. For obvious reasons, a period around the summer solstice was chosen." The birds were brought from Durham, North Carolina, after a period of training in directional orientation. The project was completed in about two weeks. It was found that the pigeons "reacted in a dichotomous fashion" to the "nocturnal" sun. The collected data required refined analysis.

Dr. John Frey, who had been at ARL in 1961 doing limnology studies of Lakes Peters and Schrader, had a return project in 1962 to study inland waters. His assistant was again Mr. Jaap Kalff, who

actually carried out the field research. His work was carried out on different ponds, some in the Lake Peters area. Pond waters "were analysed for temperature fluctuations, bicarbonate, calcium, magnesium, electrical conductivity and chloride and sulfate concentrations."

Social Science Research in 1962

The number of projects with more or less specific social implications increased to seven in 1962. Two of them were continuations from earlier investigations. One was Arctic Studies in Eskimo Culture Change and Mental Health, for which Dr. Norman Chance was the principal investigator. The June to September field work was performed by Jean Briggs, also of the University of Oklahoma, who had done the same in 1961. The scene was shifted in 1962 from Barter Island to Wainwright, after a period of background-information gathering in Fairbanks and Barrow. The study became, in part, a comparative study of changes occurring in Wainwright with those previously noted on Barter Island. Miss Briggs returned to Barter Island for three weeks in August in order to observe changes that had occurred since her previous visits. She then returned to Wainwright for the purpose of administering the "Cornell Medical Index" to all adults in the village.

A second study continued from 1961 was the Public Health Service project of radiation measurements. The project head was Jay Silhanek, but the measurements, which continued through the year, were taken by

ARL personnel, James Corwin, Gary Sides, and Otha Whitsett. The project, while technically a physical-science investigation, is included in this group because of its basic purposes.

Another project of related import was sponsored by the Atomic Energy Commission, which sent a team of three men, headed by Wayne C. Hanson, to conduct a study of Terrestrial Ecology—Radio Isotopes in Alaskan Eskimos. Amos Lane and Harvey Palmer assisted. Body counts were made of Barrow residents, including 114 persons, of which 75 were Eskimos. During the entire study more than 300 were "counted". In general the counts in Barrow people were found to be lower than in previously tested Kotzebue residents, presumably because of the greater consumption of caribou meat by the latter. The counts made in the Anaktuvuk Pass area showed higher values, presumably for the same reason as at Kotzebue.

The Eskimos were the subjects of two other studies during 1962. The National Institutes of Mental Health sent Lawrence Hennigh to northern Alaska to study the Adjustments of Eskimos to a Changed Environment. Hennigh arrived at the ARL on January 10, and five days later moved to Barrow village, where he became resident. His assumption was that his residence in the village would enable him to work much more productively. The study was related in purpose to that of Dr. Chance.

Another Eskimo study was carried on by a group from Meiji University in Tokyo, Japan. Professor Masao Oka and four assistants were in northern Alaska during April and May to study the Ethnology of Alaska Eskimos. That was the second Alaskan expedition of the group. During their two month stay, the members of the group made intensive studies of hunting and/or whaling activities, social structure, daily life, personal histories of selected individuals, and changes that had occurred in social relations. The areas studied included the Eskimos in the Anaktuvuk Pass area, Barrow, Wainwright and Point Hope, as well as some in the Publituk Creek and Tinayguk River areas. After leaving the ARL, the group continued observations at Bethel, Kotzebue, and Nome.

During 1962 two archeological studies were conducted with the ARL as the base. Both projects, pursued during June, July, and August, were mounted from Yale University. One was titled Archeological Investigations of the Nunamiut, and was conducted by Herbert, Jr. and Annie Alexander from the Peabody Museum at Yale. The project was a follow-up of Mr. Gubser's investigations among the Nunamiut during 1960-61. Excavations were made in the Anaktuvuk Pass area and also in the vicinity of Chandler Lake. The patterns found were of a type which showed short-term occupation and all but one were Eskimo sites. The exception indicated Indian occupation.

The other Yale University project was an Archeological Survey of Noatak River, conducted by Edwin Hall, Jr. and Donald House.

Investigations over extensive areas in the region during June, July, and August revealed many sites, but with very few exceptions, they were relatively late (historic) sites. Early material found in the Noatak Valley was found not to be promising.

Other Projects

A project not included in the three main classifications was the continued ARL Photography project begun earlier by Lowell Thomas, Jr. and William Baker III, of the University of Alaska.

Another activity at the ARL was the construction of a new shop building by Alaska Metal Buildings, Inc.

Summary of the 1962 Program

The 1962 program resembled that of 1960 in overall size, but the composition was somewhat different in emphasis. There were fewer (37 as compared with 44) physical-science projects, and more (7 as compared with 3) social-science projects. The program in the biological field was not greatly different (16 as compared with 14 projects in 1960).

With the occupation of ARLIS II in the spring of 1961 and the stirrings of greater interest in mounting research projects on Fletcher's Ice Island, T-3, there was a sizeable research effort on the ice in 1962, especially with emphasis on ARLIS II. The respective institutions and agencies were in the process of gearing up for serious gravity, acoustic,

magnetic, oceanographic, seismic, and other research projects utilizing the ice station as a base. Preparations for geothermal studies were being made by Lachenbruch, and the General Motors Defense Laboratory was preparing for intensive work under the leadership of Beaumont Buck. The University of Washington group under Dr. Church was less active than it had been the year before.

The investigations in the biological fields in 1962 were especially productive. As before, the projects ranged greatly in size of investigative group and in scope of work carried on. As in earlier years there was a balance between new and continued projects, with most of the larger undertakings in the latter category. To a greater extent than before, many of the major principal investigators did not themselves go to the ARL. Thus, the records indicate that Mohr, Hood, Chance, Dean, Lindzey, Frey, Schwendinger, Hussey, Woollard, Ostenso, Tedrow, Barnes, Wittmann, Silhanek and Lachenbruch did not participate in the work of the field parties.

THE ARL OPERATES ON AN EXPANDED SCALE

This section describes the administration and operations of the ARL during a period of large scale activities from July 1, 1962 through all of 1965.

In an informative letter dated July 12, 1962, the DARL informed Dr. Britton at ONR of some of the major items of interest in the midst of the busy summer season. The following parts of that letter are indicative:

"We had to cancel our last two planned landings on ARLIS II because the flux-gate compass went out on the R4D and it couldn't be repaired in Anchorage. We are now installing a polar-path compass that we obtained from AAC through Colonel Little. This is the type of compass that we have been trying to get through the Navy system for over a year but without too much success although we did get a couple of units of it.

"When the R4D returns, which should be momentarily, we will run a paradrop to T-3. The flying for ARLIS still isn't resolved but should be shortly.

"We have seventeen field parties out now stretching from Cape Thompson to the Canadian border and inland to Anaktuvuk Pass. The weather has been superb, however, and the work has been accomplished without too much strain although Murphy has had to fly an extremely heavy number of hours. Zimm and Staheli have had the R4D in Anchorage much longer than expected and Fischer is in Fairbanks readying the float plane.

The field parties report very favorably on the freeze-dry foods which we are using heavily.

"The Butler Building interior construction hasn't started yet although we expect personnel to begin arriving any day to begin the work. It is slated to be completed by 2 October. Three wanigans are in place alongside the building and the fourth about ready for placement.

"The Canadian Breaker CAMSELL passed Barrow on 9 July although the shore-fast ice is still with us. Admiral Bakutas, Kodiak, is due sometime this month and Dr. Wood also will pay us a visit."

One of the ways of gaining an impression of the activity at the ARL is to review the arrival and departure data at Barrow for ARL-connected people. Such data were kept regularly and are available. They record the comings and goings of investigators as well as of staff, even including the pilots. They also include points, other than Barrow, both within the activity range of the ARL and outside, such as arrivals from, and departures to localities in the lower states. The following are summarized for July 1962:

Arrivals and Departures

Date in July	Departures	Arrivals
1	2	3
2	4	1
3	3	6
4	2	0
5	5	5

Arrivals and Departures (cont'd.)

Date in July	Departures	Arrivals
6	3	4
7	6	7
8	6	3
9	11	7
10	2	2
11	6	3
12	2	4
13	1	3
14	13	9
15	14	9
16	19	16
17	0	1
18	0	0
19	3	6
20	5	1
21	5	1
22	5	10
23	9	16
24	3	4
25	7	12
26	7	2
27	0	0
28	4	5
29	3	3
30	5	3
31	<u>3</u>	<u>3</u>
Total	158	149

Of the departures, 87 were listed as ARL staff and of the arrivals, 83.

The record for July of 1962 lists 44 projects, including projects on ARLIS II and T-3. The number of investigators actually in the field or at ARL during the month, including assistants, but not ARL staff, was 105. These came from 18 universities and colleges and from 14 government agencies and other organizations. For February 1963,

reflecting the winter slack period, the corresponding figures are: 16 projects, 35 investigators, from 6 universities and colleges, and from 7 government agencies and other organizations. By June of 1963 the activity had climbed again and the corresponding data are: 35 projects, 89 investigators, from 16 colleges and universities and from 14 government agencies and other organizations.

The staff remained much the same as for the interval described in the section from July of 1960 through June of 1962. In July of 1962 the staff total was 55, divided as follows:

10	-	Administrative
5	-	Flying
14	-	Service
8	-	Shop
8	-	Equipment
7	-	ARLIS II
3	-	T-3
<u>55</u>		

In July of 1963 the corresponding table is:

11	-	Administrative
5	-	Flying
12	-	Service
15	-	Shop
7	-	Equipment
4	-	ARLIS II
4	-	T-3
5	-	Cape Thompson
<u>63</u>		

A few comments about the weather for every other month from July 1962 through June 1963 may be helpful in visualizing the general environmental conditions in the Barrow area. The temperature averaged

40°F in July 1962 and the range was from 27° to 64°. The wind, mostly from the west-southwest, reached a peak of 32 miles per hour on the 27th and averaged 10 mph. The sky was overcast 85 percent of the time, and the visibility was reduced by fog or drizzle on 16 days.

The latter half of September was generally stormy. In one bad storm on the 2nd and 3rd of September the winds reached 41 miles per hour. The sky was completely overcast on 25 days, and there were snow flurries and showers with steady 17 mph wind for the last 13 days. The temperature gradually decreased and remained below freezing from September 13 on.

November was a better month. The temperature dropped lower and ranged from 25°F to -30°. The average was 0°F. Winds were light out of the northeast with storm winds on only 5 days. Cloud cover averaged 60 percent with 9 days of scattered clouds to clear.

Extreme variability characterized the weather in January 1963. The average temperature was -10°F. The sky was overcast 55 percent of the time. Winds were variable and averaged 11-1/2 mph. Some days were clear and calm, others had ice fog and freezing rain. The temperature fluctuated wildly from a low of -44°F to +35°.

The average temperature in March was -21°, the winds were westerly at 8 mph, and the sky was overcast only 35 percent of the time. On the 25th the wind rose to a steady 56 mph with gusts to 62 mph.

Blowing snow reduced visibility to less than a hundred yards and all camp activity was suspended. The temperature range was from -15° to -35° .

During May 1963 the clear spring weather deteriorated into the summer overcast. Skies were overcast 90 percent of the time and the average temperature was $+25^{\circ}$. Easterly winds averaged 12 mph and there were 12 days of fog.

Many times in this history have been mentioned the many distinguished visitors and groups that stopped at the ARL for longer or shorter intervals. The DARRL and staff were excellent hosts and enjoyed entertaining and informing such guests. Nevertheless the time involved and the use of facilities at times did require substantial reduction of the ARL's capacity to carry on its other activities. Without fail, however, the staff seemed able to absorb somehow the extra load occasionally imposed. A fairly complete record of such visitors during the first of the two years covered by this chapter is included as indicative of that segment of the ARL's responsibility.

On July 9, 1962 the Canadian icebreaker HMCS CAMSELL paid a brief visit on her way eastward to the Mackenzie delta and western stations of the Canadian arctic islands. Late in the month the USS BURTON ISLAND paid her first visit of the year while carrying on studies in the Chukchi Sea. The following month several aircraft out of Kodiak stopped briefly during their ice-patrol work. The BURTON ISLAND

stopped twice in August. On the 19th a Committee on Oceanographic Facilities of the NSF, a party of eight scientists, arrived to assess the ARL as an operational center for oceanographic research. A Navy R5D from Kodiak brought in the Chief of Staff of the Kodiak Naval Station and a party of seven. Dr. William R. Wood, President of the University of Alaska, and Mrs. Wood visited the ARL for two days to become acquainted with its operation. In the following month, September 1962, the ARL played host to the crew and members of the cast of a production of the Japanese Broadcasting Corporation on The Story of Alaska.

In October members of the Nome Rehabilitation Development Conference visited the ARL on a familiarization trip to discuss the individual's rehabilitation in the Barrow area. A week later the USCGS NORTHWIND stopped briefly and the ARL was visited by Captain J. P. Martin. In November only two visitors appeared to study the problem of the rejuvenation of the village of Barrow. Finally in mid-December an attempt was made by RADM Bakutis, Commander, Alaska Sea Frontier, to land at the ARL, but he was prevented from doing so by low ceiling and poor visibility.

In March 1963 a number of visiting groups passed through the ARL and received many courtesies. On the 20th, the Geophysics Panel of Air Force Scientific Advisory Board, chaired by RADM (ret.) Paul A. Smith of the Rand Corporation, arrived and spent the night. Seventeen scientists and military personnel were in the party which was briefed on the ARL,

the DEW Line, NPR 4, and the Eskimo village. Three days later a Federal Electric Company party of 12 persons arrived for a tour and a briefing. Four days later another party under DEW Line auspices, and including a number of high ranking Canadians, was given a reception by the ARL.

In mid-April a group of Navy personnel from the Kodiak Naval Air Station, including Captain R. G. Gee, the CO, was taken through the ARL. Later some representatives of the Colorado Oil and Gas Company were taken care of by the ARL while they arranged for the shipping out of equipment purchased from the Office of Naval Petroleum Reserves.

Dr. Charles Kolb of the Army Arctic Test Board, Fort Wainwright, came in to establish liaison between the ATB and the ARL, including T-3. Representatives from the National Geographic Society and from a Norwegian daily newspaper arrived to obtain pictorial coverage of the ARL and outlying camps. On the 21st the ARL was host to Colonel Herbert Kerr, Staff Surgeon, AAC, Dr. Fridtjov Lorentzen, Royal Norwegian Air Force, and a party of AF officers. A group of consultants from the Army Corps of Engineers visited also.

Finally in June, Dr. Wood, President, University of Alaska, returned to the Laboratory for four days with his guest, Dr. Hans Georg Bandi, of the University of Bern.

In October 1962 the contribution made over the years by the DARL was recognized officially by the presentation to him of the Navy's

Distinguished Public Service Award. The award was made by the Assistant Secretary of the Navy, R and D, Dr. Wakelin, at the International Arctic Basin Symposium held in Hershey, Pennsylvania. The citation read in part: "For his outstanding contribution to the Development of the Navy in the prosecution of basic research in the arctic regions . . ." At that symposium, the DARL also presented a paper on the operation of drifting ice stations.

In an earlier section the large amount of flying required in the operation of the ARL was treated in some detail. Therefore the reader should have a reasonable understanding of the problems involved and in this section, flying is treated in summary fashion.

In July of 1962 the ARL's six aircraft, an R4D and five Cessnas, flew a total of 232.4 hours. The various field projects received required air support throughout the summer. Some help in supplying ARLIS II by drop was obtained by chartering a commercial C46 for some missions. In October only 63 hours were flown by ARL aircraft due largely to poor weather and mechanical difficulties.

On October 28th Royal Canadian Air Force, in a most commendable spirit of cooperation, sent a C130B to assist in supplying fuel to ARLIS II. As reported in the ARL monthly report: "The aircraft made the first of two proposed flights to ARLIS on the 29th, stopping briefly at T-3 to off-load equipment and replace the weight with additional diesel oil.

Unfortunately, in making the approach to the airstrip at ARLIS the aircraft struck an unmarked diesel drum which had been set on a three-foot knoll 200 feet back from the runway to mark the center-line. This collision tore several holes in the skin of the fuselage, aft of the wing, which made it impossible to pressurize the plane thereafter. Eleven ribs were either bowed or broken at this time as well. Further, the impact stress at touchdown was over 3 G's, which is more than the aircraft was designed for, and compounded with the long-wave surface of the strip which accentuated the bouncing, the result was that the starboard main gear suffered considerable damage. The aircraft returned to Barrow at middle altitudes cruising on only the two inboard engines, averaging 190 knots nonetheless, and landing without further incident. The following day and a half were spent by the crew in removing the landing gear covers and chaining the wheels together to prevent their splaying-out on touchdown and causing the plane to belly land."

Because an icebreaker had been unable to reach ARLIS II in the summer of 1962 and because of the accident to the RCAF C130 it became necessary to arrange for the paradropping of fuel to the station. MATS took on the job on a charter basis, and operating from Elmendorf AFB at Anchorage, six C124's made 15 flights on 12 days carrying an average of 21 barrels of fuel each. A few of the drops were lost, but generally it was a very successful mission especially in view of the darkness at that time of the year and uncooperative weather.

The flying record for calendar year 1962 was 2,046 hours —835 hours multi-engine and 1,211 hours of single-engine flying.

Late in January 1963 the DARL and his assistant flew to Fairbanks to negotiate the sale of the two oldest Cessna 180's and to make arrangements for two new ones. During April 1963, 160 hours of flying were done by the ARL's three Cessna aircraft and 32 hours by the R4D. In addition Wien Alaska Airlines flew 12 charter flights of a DC4 to T-3 with POL and freight. Finally 5 flights were made by a Navy P2V in support of a geomagnetic study. A total of 440 hours of flight time was logged in support of 55 investigators working on 25 projects. The two new Cessnas were received in April.

In May 1963 the gravity program was extended to ARLIS II and by a flight of two aircraft on to the North Pole where a gravity station and depth soundings were made. That was the first known landing of a single-engine aircraft at the Pole and the deepest penetration of the Arctic Ocean by light planes. It was concluded that light aircraft could operate without serious difficulty to the Pole.

Minor maintenance went on on ARLIS II during July 1962. Storms moved and rotated the ice island more than usual during that month. No flights reached the station in July or in August. Storms also plagued the station in August. Several paraprojects helped supply the station. The monthly report for August listed seven projects underway. In September a good deal of effort went into getting the airstrip ready for the season

when aircraft again could land. The first landing of the season was made by the R4D on September 26. On the 27th a shock wave was recorded—presumably from a nuclear test, and on the 22nd of September another was felt.

Beginning in December 1962, ARLIS II had a series of breakdowns of generators that constituted a real problem for the rest of the winter and was not solved until the generators were replaced in the spring. At the end of the year ARLIS II was at $84^{\circ}40.6'N$, $173^{\circ}40'E$.

January of 1963 was cold. For ten days in that month the temperature remained below $-40^{\circ}F$ and once reached $-58^{\circ}F$. Gary Sides was rotated out as Station Leader in February and John Beck returned temporarily as Leader during the conversion that month of some of the stoves from diesel fuel to propane. Beck, according to plan, was replaced by Harold Strong in March. During March the whole pattern of power use and heating at the station was revised in order to insure adequate power and to conserve fuel. Supplying fuel to the station was a continuing urgent problem. The new plan was activated so far as possible and was completed in May. Harold Strong departed as Station Leader in May and was replaced by Carl Johnston.

Activities on ARLIS II during June 1963 included full attention to resupply before the runway closed for the summer on the 22nd. Gary Sides returned as Station Leader and Carl Johnston, who had been Leader

for 23 months of the Station's 25-month life, returned to the lower states for a well deserved vacation. Nine men were left on the ice island for the summer. The record shows trouble with five polar bears during the year—one in July 1962, one in August, two in September, and one in March 1963. Two had to be shot.

During July 1962 most of the buildings at T-3 were moved from the ice pedestals that develop under buildings. The area was levelled and the buildings reset in an improved grouping. On the 23rd the nuclear submarine USS SEADRAGON visited the station while enroute to the North Pole. Movement of some of the buildings was necessary again in July as the surface of the island melted. A new runway parallel to the old one was started. In September Gary Sides relieved Robert Mellen as Station Leader. On September 11 the icebreaker USS BURTON ISLAND arrived at the Station at $78^{\circ}45'N$, $166^{\circ}W$. That was a record penetration north of Alaska, 120 miles beyond any previous free-moving surface vessel. She filled 640 barrels with diesel for the Station before departing on the 13th. The first landing of an aircraft on the station was by the R4D on the 17th. Through October and November the Station experienced a good deal of trouble with tractor breakdowns and generator failures. Robert Sutton, new Station Leader, an expert in mechanical equipment, took over from Gary Sides late in November. At the end of the year T-3 was at $81^{\circ}12'N$, $161^{\circ}45'W$ in 3437 meters of water.

By February of 1963 the return of the sun brought a marked increase in activity. New facilities were built for Lachenbruch's Geological Survey project, and the messhall galley complex was enlarged and improved. Maintenance of equipment was difficult in March, but two new generators were brought in and the air strip lengthened to permit resupply, especially of POL by the chartered Wien DC4. The principal April activity was the receipt of 143,000 pounds of freight by the Wien DC4. This was to stock both T-3 and ARLIS II by forward haul by the ARL's R4D. Fuel, as usual, was the large item. R4D shuttle landings between T-3 and ARLIS II were made as late as June 23, ten days later than the last landing the year before.

The ARL was in full swing in July 1962. During the month 41 projects were underway by 101 investigators supported by a staff of 53. Hut 5 was completed, and the Brewers moved in. The crew went immediately to appurtenances for the new shop building. By September the summer activities began to slacken, and reorganization for the rapidly approaching dark season began. Fourteen projects terminated in September leaving twenty-six active. Full maintenance attention was given to the camps at Anaktuvuk Pass and at Peters Lake with some repainting of interiors and the closing of both camps for the winter. A good deal of time went to storing the 300 tons received on the shiplift as a large amount of rearranging was necessary. Similar work went on in October; there

seemed to be no end to urgent chores. The October report says—"The gravel hauling was finally brought to a close by the freezing of the beach gravel but the manpower was then used to fill 700 barrels of diesel oil for airlift to ARLIS."

The December 1962 monthly report summarized maintenance work for all of 1962. The shop personnel, in addition to support of the projects:

Constructed - 4 wanigans, 14 feet by 20 feet, for the new shop;
2 mechanical rooms, 12 feet by 15 feet, for the shop;
4 wanigans, 14 feet by 20 feet, for the new animal-house complex;
1 passage, 8 feet by 38 feet, for the new animal-house complex;
1 wanigan, 14 feet by 28 feet, for Anaktuvuk Pass and another one for the aircraft hangar;
2 wanigans, 12 feet by 20 feet, for Camp Putu and for a project on CO₂ content.

Remodeled - Family quarters 5;
Family quarters 6;
Dormitory building 251.

Sided and Painted - A wanigan 12 feet by 16 feet;
The north end of Building 251;
Refrigerator rooms.

Repaired and Painted - Building 250, lower laboratories and passage;
Building 251, lower passage and coffee room;
Family quarters 1, 4, 6, and 7 passageways;
Repaired, painted, and winterized field station at Peters Lake.

Equipment personnel maintained and serviced the motor pool of sixteen weasels, sixteen jeeps, nine 3/4 ton trucks, three 1 ton trucks, and three tractors. They maintained and operated the two small vessels—

NATCHIK and LIZ MARU, leaving the former in Nome for the winter.

They loaded and unloaded uncouneted aircraft and hauled a great deal of beach gravel for pads for new buildings.

By April of 1963 the pace had begun to quicken again as spring approached. The Laboratory in that month supported sixty investigators involved in twenty-five projects. A small, temporary ice-floe station was set up 106 miles northeast of Barrow for an acoustics program. It operated between April 7 and 24, was supported entirely by light aircraft and was exceptionally economical. The AEC camp at Cape Thompson was officially transferred to the ARL early in May. Also an abandoned DEW Line building at Demarcation Point was acquired and added to the ARL field-camp complex. Figure 2 is a sketch of the locations of field stations as of the summer of 1963.

Activities increased greatly in June as had become usual. Twelve new projects were initiated. The ARL that month received eight wolf pups from Anaktuvuk Pass for use in studies at Barrow. Two were shipped to Dr. Robert Rausch at the Arctic Health Research Center in Anchorage. The support line from ARL was extended in mid-June in order to establish and maintain a new field camp on Banks Island in Canada.

In July 1963 ARL aircraft logged 288 hours of flight time—36 hours in five flights by the R4D and 252 hours in sixty-four flights by the Cessnas. Aircraft activity began to slacken in September. On the 22nd of that month one of the Cessnas broke through a frozen crust on a dry lake bed in a

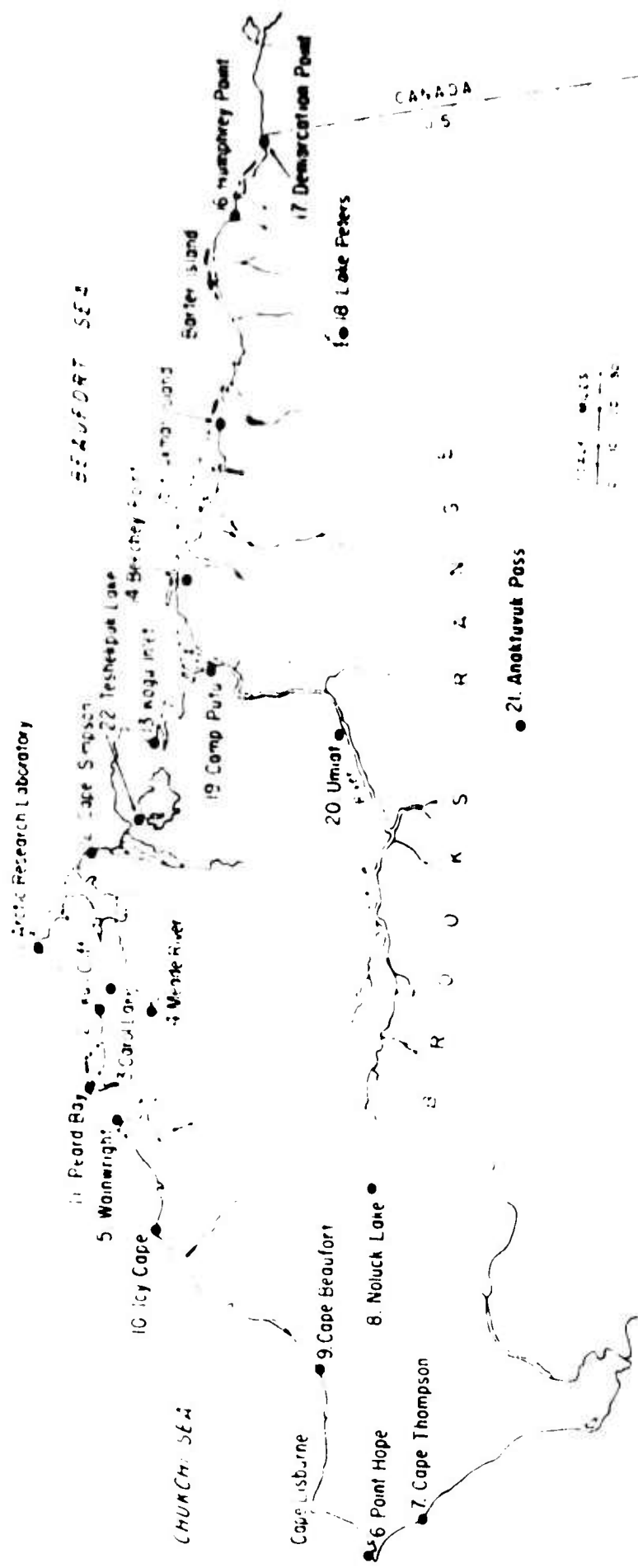
landing about 30 miles from Barrow and gently nosed over. Damage was slight, but the men had to walk in. The aircraft was found the next morning, and plans made for a repair expedition in October which returned the aircraft on the 28th of that month.

Damage to aircraft and hangar facilities in the exceptional storm of October 3 will be mentioned later. Flying after the storm was limited. One Cessna operated from the new, partially completed, airstrip at the village until the ice on the lake near the ARL was thick enough to use. Support facilities, however, were non-existent. Another Cessna operated from the remaining usable portion of the airfield at the camp. The R4D (No. 217) was damaged in the storm and was due an 8000-hour inspection anyway, so it was under repair. A second R4D (No. 776), in much better condition and with super R4D engines, arrived at the ARL on the last day of October.

In mid-December the old R4D was flown to Los Angeles for complete repairs. The total ARL flight time for 1963 was 1812 hours. Of those, 726 were by the R4Ds and 1086 in the five Cessnas. Wien Airlines in charter flights flew 424 hours for the ARL, mostly fuel supply to the ice islands. Other aircraft, P2V and B17 mostly, flew an additional 225 hours in support of ARL projects. Altogether air support was furnished by 10 aircraft in 2461 hours and a total of more than 390,000 miles.

In February 1964 a total of 138 flight hours were logged. Thirty eight of those hours were in 16 flights of the Cessna 180's, 62 in 11 flights

Figure 2 — Location of Arctic Research Laboratory and satellite field stations.



From Max Britton, BioScience, vol. 14, No. 5, 1964, p. 44.

of R4D 776, and 38 in the Wien DC4. In addition a MATS C130 made five flights to ARLIS II from Thule, Greenland, with diesel fuel and a replacement D-4 tractor. In the following month 373 hours were logged, a very large increase. In April the hours again went up to 405. However in that month R4D 776 lost an engine on ARLIS II and was down on the station at the end of the month. The old R4D, No. 217, was back in business after overhaul in Los Angeles in the latter part of the month. The flying program in April was handicapped by the necessity of searching for, and then rescuing, polar-bear hunters in two aircraft that had crashed about 30 miles off shore.

A Navy VX6 squadron assisted the ARL in May with C130 aircraft. One flight was from Resolute, NWT, to ARLIS II with aviation gasoline for the R4Ds. Two flights hauled gasoline to T-3, and in 12 flights diesel fuel was moved to T-3 from Thule. One of the flights to T-3 carried an engine for R4D 776 that had been down since April, and it was able to return to Barrow.

The last landings in the summer of 1964 on the two ice islands, T-3 and ARLIS II, were made on June 9 and 10. Flying then was directed primarily to the support of summer field parties on land. In July an unusual flying chore was to transport 10,000 pounds of lead bricks from Kotzebue to Arctic Village for a radioactivity project and then back to Kotzebue. During August, whenever possible, the ARL aircraft obtained ice-reconnaissance information for the various ships along the north coast.

On the 17th and 19th respectively of September, the first landings of the winter season were made on T-3 and ARLIS II. The flying hours in September 1964 were only 75 for two of the Cessnas and 80 for the two R4Ds. Two R4D flights were to T-3, and one to ARLIS II. On the latter trip the R4D stopped to refuel at Alert, NWT, and this became standard in that winter because of the distance of ARLIS II from Barrow.

The normal routine of ARLIS II was broken in July by the illness and untimely death of one of the researchers, Jay Hirschman, of the gravity and magnetic program of the University of Wisconsin. The story is best told by quoting from the official report of the Station Leader, Gary L. Sides: "On the 9th, Jay developed a rapid pulse and serious lung congestion and was confined to bed and given oral (anti) biotics, at the suggestion of the Barrow PHS Doctor, who had been called to the ARL radio station to give advice and diagnosis. Two days later an aerial resupply was readied as Wien had completed the installation of long-range fuel tanks in their DC4, and it became practical to haul large quantities of freight to the islands without the need to refuel enroute. . . Dr. Light from the Barrow hospital accompanied the flight and discussed Jay's condition with the station personnel while the plane flew overhead in the course of dropping its cargo. The improved radio contact allowed the Doctor a better idea of the nature of the case. By virtue of Jay's response to treatment it was felt that the diagnosed pneumonia was over, as Jay appeared and felt much better. . .

"On the 13th Jay's condition took a turn for the worse with an old asthmatic condition complicating the diagnosed pneumonia, and Jay felt ill enough to request immediate aerial pick-up and removal from the Ice Island. Two days later, while the aircraft chartered for the pick-up was held in Fairbanks, Jay again improved, and following discussions with the station personnel, he requested that the aircraft be released to return to its home field. Discussions were also held in Barrow with the PHS Doctor and it was felt that all signs as of this time indicated Jay's condition had improved and that his request should be honored, particularly since aerial pick-up can be a disconcerting experience. The aircraft headed south from Fairbanks on the 17th after waiting two days while Jay's condition was observed.

"On the evening of the 27th, following a radio blackout during which no contact had been made with ARLIS since the morning of the 26th, it was reported that Jay had again suffered a serious relapse the night before and had been in a coma throughout parts of the day. Jay requested, and the station personnel advised, that he be evacuated at the earliest possible moment. In the course of this contact Jay collapsed . . . and died.

"Subsequently it was found that he had died of a heart attack brought about by a malignant tumor. . .

"Throughout this trying period all personnel on the station showed a most thoughtful and understanding attitude and accounted for themselves

in an outstanding fashion even though radio contacts again dipped in number, to 64, and there were nine days with only one contact and three days with none. . ."

In August and September 1963 the whole ARLIS II camp was moved because of the pedestaling of buildings, a new runway was built, and the camp winterized. The first landing of the fall was made at the station on September 26. There were no flights to ARLIS II in October because of the phenomenal storm at Barrow which will be described later. November was a busy month of resupply, but communications difficulties and mechanical problems with the aircraft limited the operation.

In December for the first time ARLIS II began to give signs of drifting out of the Arctic Ocean by way of the Greenland current. All month it remained above 88°N and continually moved eastward so that by the end of the year it was at $69^{\circ}58'\text{W}$. Only one flight reached the station in December—on the 23rd. Outbound to Barrow went Adam Leavitt, an Eskimo workman, with the distinction of being the most northerly recipient of orders to report for Selective Service physical examination.

During January of 1964 the weather was bad on ARLIS II with a great deal of drifting snow. Fuel became critical, and efforts were renewed to get fuel delivered by C130 aircraft from Thule, which was only half as far from ARLIS II as Barrow. The first load of fuel from Thule arrived on February 19. In March the fuel shortage was over—that month

there were eleven C130 flights from Thule, two Wien DC4 flights, and two R4D flights. April 1964 was characterized by a great increase in radio communications by the establishment of daily contact with the Staib North Pole expedition, Thule, Alert, and Oslo, Norway. More people visited ARLIS II in May than had come since May 1961. Three ARL pilots had to lay over until an engine was replaced, a Japanese party visited, and the Staib North Pole party came aboard. On May 8 there were 22 people and 31 dogs in residence. The Staib party was evacuated to Thule by a returning C130.

In July 1964 the big event was a paradrop from a Wien Alaska Airlines Constellation on the 29th. It had been a long time, June 9, since mail and fresh produce had been received. Much of August was spent in combating water from rain and the melting of surface ice. The camp was moved to a better location. On September 19 the first landing on ARLIS II was made by an ARL R4D. At the end of that month the station was at 85°54'N, 23°55'W.

The outstanding activity on T-3 in July 1963 was the retrieval of bottom cores up to 9-1/2 feet long from as deep as 3740 meters. As the Island drifted over the Alpha Rise, the sea shallowed to 3500 meters. A new runway received its first aircraft on September 11. On November 21 Jimmie Crestman returned to T-3 from ARLIS II and resumed his responsibility as Station Leader. He relieved William Beck, who returned to

Barrow. In December only one flight landed at T-3—an ARL R4D on the 22nd with Christmas supplies. At the end of the year the Station was at 81°50'N, 142°44'W.

Nine flights came in in January 1964 although the month was very cold. Early in the month the temperature remained in the minus 60's for three days. At the end of the month the temperature dropped below minus 70°F. Operations were routine in February, March, and April. There were numerous landings; many were stopovers enroute to ARLIS II.

There were a good number of fuel flights in May and June before the airstrip was closed for the summer on the 10th of June. In May were 14 flights of C130 aircraft that brought 551 drums of diesel and 94 drums of aviation gasoline. Seven R4D flights landed in May, but all but two were for ARLIS II. Five R4D flights came in June before the strip was closed. September 1964 was spent preparing for the winter. On September 17 the first R4D landed. Near the end of the month, September 29, the station was at 80°13.6'N, 137°32'W.

ARLIS III is a good example of the kind of program that can be supported by the ARL without much cost and based on the experience and initiative of the ARL staff. ARLIS III was established to fill the need for an ice-floe station from which to carry on geomagnetic, telluric-current, and auroral studies in the early spring. It was recognized that other projects might also use such a facility once it was established. The

station was to be located 160 miles to 200 miles northeast of the ARL where, if it followed the normal drift pattern, it would pass from deep ocean to over the continental shelf in a few weeks.

After several delays because of bad weather and poor visibility, ARLIS III was established on February 10, 1964 at 73°N, 151°W. The process is well described in the ARL monthly report for February 1964:

" . . . Two Cessna 180's landed first with two passengers and the station radio equipment: The R4D landed shortly afterward with two passengers and 6000 pounds of freight including one complete prefab 12 x 16-foot building. Construction of the building began immediately and was completed that evening in spite of temperatures that ranged from -40 to -48°F. The Cessnas remained over night to provide the construction crew with a get-a-way capability in case of necessity before shelter was available and radio contact with Barrow established. There are several landing strips, the longest 13,000 feet, in the area. Only two or three inches of snow allow good operation of the R4D on wheels.

"The R4D delivered two loads, 13,000 pounds, of construction materials, fuel and scientific equipment on the 11th. By the evening of the 13th in spite of (the) temperature never having risen above -40°F, construction of the Camp was completed and all supplies moved, by manpower, from the runway to the Camp which consists of the following:

1. A 12 x 16-foot combination mess-hall and instrument building;
2. A 12 x 16-foot dormitory wanigan;

3. A 6 x 6-foot generator building;
4. A 6 x 8-foot generator building;
5. A 6 x 8-foot cold laboratory;
6. A magnetometer hut.

"On the 14th, the R4D delivered additional scientific equipment, fuel and food supplies sufficient to last 30 days, brought in the balance of the permanent crew, and rotated out the construction crew. Establishment of the scientific program was initiated on this date." Operation of the station was routine in March. The Cessnas made five flights to the Station and a number of visitors were brought in and returned.

The projects for which the Station had been established were completed by April 10, 1964, and normally the Station would have been closed after that date. However, it was decided to keep it open for a while for possible use by a NAVOCEANO group and as an advance staging area for an offshore gravity survey supported by the Cessnas. It was so used until May 9. A few days later the Station was closed by hauling out a generator, the homer beacon, and the people. The buildings and miscellaneous supplies were abandoned as not being worth the cost of removal.

In 1963 summer activity reached its peak. Investigators, engaged in thirty-nine projects, were spread from Bettles to ARLIS II, about 1560 miles, and from Nome to Banks Island, about 1360 miles. The work of support was typical for the busy peak season and is quoted from the July

monthly report as a sample of the nature, variety, and amount of support supplied.

"In addition to the work directly associated with the scientific projects, the shop and maintenance staffs expended 673 man-hours on the ARL hangar; recovering the ends with plywood, painting much of the building, and siding the dravo room. They spent 398 man-hours building new fox and wolverine cages, and 299 hours readying the boats NATCHIK and IVIK for summer use, and operating the NATCHIK. They also: built two 6 x 12-foot wooden wolf cages and two 4 x 6-foot wolverine cages for the Folk project; sided and painted the wanigan at Putu, and built an 8 x 12-foot storage/generator building there; painted the Noluk Lake wanigan, both exterior and interior; rehabilitated and painted the wanigan at Meade River; surveyed the needs for rehabilitating the Demarcation Point Station; loaded approximately 100 tons of equipment at Cape Thompson aboard the barge for shipment to Barrow; positioned a wanigan, and power lines for the DECO project; constructed a new 14 x 20-foot wanigan; painted the LCM LIZ MARU; and, kept the ARL vehicle fleet operating in reasonably good condition. The latter was difficult due to the unusual number of weasel tracks broken this summer. The shop personnel also built 100 paradrop boxes."

In August the field camp on Banks Island was deactivated. The DARL felt that if future work was done in that region it could be supported best by stationing one of the Cessnas at Sachs Harbor where the utmost in cooperation had been extended by the Canadians.

At the end of August the ship of the Bureau of Indian Affairs, NORTH STAR, arrived off Barrow but could not unload until September 8 because of strong winds and high seas. Of the 4500 tons consigned to Barrow, the ARL received four new jeeps, four new trucks, more than 100 tons of lumber, 1200 gallons of paint, hardware, and fifteen tons of staple food supplies. ARL also took delivery of seventy-five tons of drilling supplies for the Office of Naval Petroleum Reserves. All supplies were warehoused by the end of September.

October 1963 was the month of "The Storm". The report of that major catastrophe is contained in the monthly report and is quoted, with some deletions, because it expresses so well the situation as it developed, passed its climax, and receded.

"The program at ARL suffered a serious set-back on 3 October when a freak storm caused the Arctic Ocean to flood the Barrow Camp resulting in extensive damage . . . and considerable loss of equipment and supplies . . . Two projects . . . were wiped out. Two other projects . . . suffered heavy losses and face a considerable delay in their re-establishment. All projects suffered inconvenience and delays in routine while the Camp facilities and transportation were being reactivated. These delays included the fall fuel re-supply to ARLIS II . . . which had to be delayed due to the airstrip at Barrow Camp being unusable.

"The storm . . . is without parallel . . . in . . . the recorded or legendary history of the area, although a series of heavy storms . . .

occurred in 1964. A chronology of the storm . . . follows:

- "0000-0600 Although winds . . . high, no damage . . . sustained . . .
- 0600-0800 The ocean began to rise and show the first manifestation of the coming wind tide. Water and wave action reworked the beach but did not enter camp;
- 0800-0930 Water undermined the tower at CO₂ and began undermining the CO₂ wanigan . . . The runway was closed to aircraft. Water began to cross the road between the airport and Camp. The amount was minor at this time, it was still thought that Fresh Lake could be saved, and much of the camp effort was expended trying to save it;
- 0930-1100 Water approached the first row of buildings . . . covered the runway, and was about 1-foot deep flowing into Fresh Lake. Wave action moved the LCM . . . anchored with a D-8 Cat and TD-24 tractor, and the IVIK. The fate of Micromet and NATCHIK were unknown at this time;
- 1100-1300 Water was entering Camp during this period but still not enough to cause alarm for the camp. Fresh Lake now was beyond saving;
- 1300-1400 Winds increased and power lines were breaking too fast to be safely cut individually. Camp power was

shut off to prevent fire. Water entered the camp, pounded all the beach buildings, and entered the Boiler House. The steam plant was shut down. About one foot of water was flowing over the main street of camp. George Riedel's plane was swept away. The Lodestar was turned around by the force of the water;

1400-1600 The peak of the storm occurred . . . Water rushed through Camp reaching a depth of twenty-four inches in front of the main ARL Laboratory complex and as deep as 3-1/2 feet in other areas. Building 161, the beach-master's hut, the theater, and F-5 were moved off their foundations and the 40 x 100-foot gym collapsed. Building 161 came to rest out on the tundra behind Building 355. Salt water poured into Fresh Lake in a two-foot depth stream as wide as the distance between the Camp and the airport. All women and children were evacuated from the Camp to the DEW Line site. Most of the damage in the area occurred at this time. The force of the current through Camp was so strong that only Cats could safely be driven through the streets. A wolf, two wolverines, and three foxes drowned in this period. One weasel and one D-4 Cat were sunk

trying to save the animals. Folk's wanigan was swept over the gas line."

Loss and damage was great indeed at the ARL, elsewhere in the camp area, and in the village of Barrow. Only a few of the major losses are noted below:

Selected Items of Loss and Damage at the Camp

1. Salt damage to most vehicles, including several which were sunk but retrieved later.
2. Undermining of many buildings with consequent damage to foundations and floors.
3. Salt water damage to three aircraft.
4. Heaters, refrigerators, plywood, masonite, foodstuffs, and other supplies water and salt soaked.
5. Fuel, poles, lumber, and other supplies scattered over the tundra.
6. Fresh Lake lost for use—salinity after the storm 57 percent that of sea water.
7. Loss of steam and water lines between boiler house and main buildings.

Selected Items of Loss and Damage in the Village

1. Thirty-two houses dislocated, fifteen of them destroyed.
2. Five warehouses, stocked with food, damaged.
3. Three aircraft lost.

4. 250,000 gallons of fuel lost.
5. A major gas line destroyed.
6. Small boat damage of about \$50,000.
7. Food and clothing loss of about \$50,000.

The DARL gratefully reported: "Personnel of the area, ARL, Vinnell, Federal Electric Corporation, and those in the Village responded magnificently and saved much equipment that appeared to be doomed. ARL personnel, staff, and investigators, including some who were not familiar with it, were operating equipment hauling supplies out of the way and wading through water up above their knees trying to help. The same spirit continued after the storm, and by the middle of the month, most operations were back in business even if not at peak efficiency."

During the remainder of 1963 the ARL staff was unusually busy supporting projects underway, carrying on planned improvements and normal maintenance, but mostly in clean-up, repairs, and salvaging of equipment following the storm. Normal servicing and maintenance activities went on during the first three months of 1964. Of course, the extra work occasioned by the storm continued, but the work load gradually returned to normal. During January, February, and March all work was inhibited by unusually cold and windy weather.

In January the average temperature was -20°F and the minimum was -49°. The wind averaged 12 MPH. In February the average temperature

was -28.6°F , 10.3° below normal, and the minimum was -54° . March warmed up a little to an average of -23.3°F and the winds decreased markedly.

"Reorientation of the program on ARLIS II, opening the Cape Thompson Camp, maintaining the Anaktuvuk Station on an essentially standby status, repairing storm damaged buildings, work on the new seismic observatory, and running two full-time gravity measurement programs, as well as the normal support of 32 projects at ARL and on the ice stations, continued activity at ARL at a high level during April (1964)."

The possibility of a new laboratory had been discussed for years by individuals and groups interested in the ARL and its programs. In May 1964 came concrete evidence that a new building some day might indeed become a reality. In that month representatives of ONR, the Bureau of Yards and Docks, the ARL, and an architectural firm met in Fairbanks to discuss some of the general specifications of the proposed new building. The architect also went to Barrow to make preliminary surveys and study permafrost conditions.

In the first part of June 1964 priority in support effort was given to getting personnel and supplies on the two ice stations before the airstrips became unusable for the summer. This work was completed by June 10, and efforts were turned to support of land stations. In 1964 they

were widely scattered. In June, for example, the following field stations were activated—Cape Simpson, Teshekpuk Lake, Putu, Umiat, Anaktuvuk Pass, Noluk Lake, Cape Thompson, Cape Beaufort, and Skull Cliff. In addition tent camps were established at Noatak, Kukpuk River, and a project was moved to the Canadian Laboratory in Inuvik, NWT. A pleasant incident in that month was the return to the ARL for several days of Dr. and Mrs. G. Dallas Hanna, a former Director.

July, as had become customary, saw a visit to the ARL by the North Star Arctic Orientation Group of the Air Force. Each year the Air Force sponsors such a group of distinguished officers and educators to promote awareness of research interests in the Arctic. Such educators in 1964 included:

Dr. Edwin D. Harrison	- President, Georgia Institute of Technology
Dr. Melvin R. Lohmann	- Dean of Engineering, Oklahoma State University
Dr. William E. Morgan	- President, Colorado State University
Dr. John N. Stauffer	- President, Wittenberg College
Dr. John R. Van Pelt	- President, Michigan College of Mining and Technology
Dr. Logan Wilson	- President, American Council on Education
Dr. William R. Wood	- President, University of Alaska

On August 21, unusually late because of bad ice conditions, the annual shiplift arrived and off-loaded 405 tons for the ARL. Earlier, on August 2,

the CS CAMSELL, the Canadian icebreaker and supply vessel for Canada's western Arctic arrived and visited the ARL before proceeding on her mission eastward.

Thirty-one projects were still active in September 1964, and attention began to be given to cleaning up after the summer rush. The following were done that month and illustrate the nature of such annual activity:

1. Continued rehabilitation of the Cape Thompson Camp (665 man hours).
2. Continued rehabilitation of building 265 (615 man hours).
3. Continued rehabilitation of building 247 (240 man hours).
4. Continued construction of animal cages (202 man hours).
5. Continued clearing of area behind the ARL of storm-piled debris, especially old oil drums (186 man hours).
6. Completed storage of ship resupply items (308 man hours).
7. Hauled gravel for the laboratory area (701 man hours).
8. Hauled gravel for the NASA trailer pad (259 man hours).
9. Started construction of a wanigan for NASA (140 man hours).
10. Other work for the NASA project (84 man hours).

For that month were listed the following personnel:

Administration	- 11	Shop	- 9	T-3	- 3
Aviation	- 6	Equipment	- 13	Cape Thompson	- 5
Service	- 11	ARLIS II	- 5		
				<hr/>	
				Total	- 63

By October 1964 interest in the possible new building was picking up, and the DARL clearly was starting the project with the ARL staff. In that month Dr. Britton wrote the DARL with inquiries about the cost of setting piles for the new building. Britton also was concerned about the DARL taking time to survey the position of the piles and similar activities. Further he wanted estimates of the cost of ARL services and materials furnished or to be furnished in the first increment of construction. In mid-November the DARL reported that 1903 loads of gravel, aggregating 22,800 cubic yards, had been hauled for the foundation pad for the new building.

By September of 1965 ONR reported to the DARL that the new ARL building and the proposed new hangar were still in the military-construction bill for 1967, and it was hoped they could be kept in. The new laboratory was priced at \$3,000,000 and the hangar at a little over half that amount. At Christmas time it was known that the laboratory was still in the picture but that the hangar and some proposed new family housing had been eliminated.

A letter dated August 17, 1965 from Max Brewer to a friend in Seattle illustrates some of the complications of the life of the DARL at Barrow. The friend apparently had bought a large amount of surplus equipment at the old Navy camp and left it scattered on the beach where it had been strewn about and partially covered by sand in the violent

storm already described. The DARL was trying to get the buyer to move it away and suggested several possibilities. He said, "The storm of October 1963 cut the Spit in the middle of the junk row and washed much of the junk into Elson Lagoon where according to the Natives, it now presents a hazard to navigation (skin boats). They complained to Senator Gruening, who gigged the Navy which stated that it was a Coast Guard problem. The Coast Guard pointed out that Elson Lagoon, being an inland waterway, was a Corps of Engineers problem." And so it went. He also informed his friend of the great changes in the Barrow area. "A new high school, new hospital, new school apartment building, and new nurses quarters, all strictly South 48 quality, are now under construction in the Village. They also have natural gas to the Native homes, an item that above all others, will tend to promote better housing over there. The Camp is in better shape now than it has been since 1954 as the Air Force and its new contractor, Vinnell Corp., are making a determined effort to clean it up and keep it in reasonable repair."

Late in the fall of 1964, the DARL made some studies on the cost charged by the Air Force for vehicle repairs over the fifteen months from June 1964 through August 1965. The figures are revealing, but need to be considered with some knowledge of their validity. They show that truck repair, labor plus parts, cost \$1,311 per month; jeep repair \$380 per month; weasel repair \$400 per month; and other repair \$2,885 per month.

For example, the apparent cost of weasel repair is much too low because the ARL performed most of the maintenance on those vehicles with its own staff. The cost of weasel parts is low because many parts were cannibalized from old weasels, and because the ARL had many weasel parts left over from Pet 4. So too the cost of jeep repairs is really too low because the ARL had a large supply of jeep parts. Conversely, the truck repair costs are too high because the record includes modifying the trucks for oversize tires.

Around the end of October 1965, the DARL was chafing under the pressures of the Resident Auditor in Fairbanks. He pointed out to ONR in Washington that "Admittedly the ARL contract document is generalized considerably to allow flexibility. This drives the auditor wild as it doesn't give him many specifics on which to hang his hat." He pointed out the long delays experienced by the Vinnell Corporation, with a detailed and specific contract, in getting authorization to clean out the old fuel barrels from a lake near the camp so the lake could be used for the operation of small aircraft on floats. He said "Vinnell has been requesting authorization to do this work for 18 months—ARL did it with personnel available, without any particular authorization other than good management, and the float planes got in two summers of flying while waiting for the AF okay to Vinnell."

A much needed general memorandum to all investigators from the DARL was prepared for 1966 and it proved most useful. It was six pages

long and packed with explanatory material, rules, regulations, and other information needed by new and experienced investigators alike. It was titled "Operations, 1966" and just the major headings indicate the nature and value of the content—

Introduction	Transportation
Fairbanks/Barrow Transportation	Aircraft and Boats
Clothing	Shops and the Camp Contractor
Camp: General - Meals - Coffee Shop	Mail and Freight
Laboratory Facilities and Staff	Laboratory Operations.

Mercy missions over the years had become almost a routine part of ARL operations. Another one was performed by pilot Robert Murphy late in September 1964. Mrs. Emma Okteaha, a Barrow Eskimo, had become dangerously ill and required either quick medical treatment or immediate evacuation to Fairbanks. Just 32 minutes after the DARRL was notified, pilot Murphy took off from Barrow in one of the ARL Cessnas and with poor visibility and only a 400-foot ceiling, flew to Wainwright, picked up a doctor of the Alaska Native Service and returned him to Barrow. Mrs. Okteaha responded to medical treatment and did not need to be taken to Fairbanks.

A few recent personnel changes were reported by the DARRL to Dr. Britton about the end of October 1964. One pilot had to be terminated

because he "was letting personalities get a bit the better of his judgment."

A new pilot was hired without difficulty. An Eskimo was let go for failure to show up for work. A retired Navy officer and pilot was hired for an administrative position, and a former employee returned to reinforce the back-up for the station on the ice.

The constant coming and going of distinguished visitors to the ARL has been reported many times in this story. A high point of some sort in this respect occurred in mid-July 1965. Several Air Force and Navy officers arrived on the evening of the 14th. The next day, while the earlier visitors were still there, the Canadian Coast Guard ship CAMSELL arrived for several days stay. At 1300 on the 15th a group of high ranking military officers and university presidents arrived overhead and landed after 45 minutes circling because of a low ceiling. A Navy aircraft with U. S. Senator Ernest Gruening and the Commandant, 13th Naval District, RADM Farrell, appeared at 1515, circled because of the low ceiling and landed at 1630. That one was rough. The DARL reported—"On their final approach the hydraulic line on the plane ruptured, the plane landed with only half the normal flaps, they pulled the emergency brake, blew four tires, and one set of wheels plus the nose wheel of the C-54 ran off the runway and buried themselves in the loose gravel. No one was hurt and we unloaded the Senator and Admiral down the ladder in a completely unflustered condition . . . After the Senator arrived, we gave a briefing

on ARL for the groups, had a social hour for all including Village representatives, dedicated the Natural Gas System in the Village, and watched a Native dance. . . Frankly, four different visiting groups at once make life a bit hectic. However, according to the grape vine, everyone was pleased, the University people had a chance to talk with the investigators and Village residents, and John (Schindler) and I had a chance to talk to Senator Gruening, Admiral Farrell, General Combs, Bernt Balchen, and others. Senator Gruening discussed the new lab at considerable length. . . We hope that some of the intangible results from this week some day become tangible."

It was necessary near the end of 1964 for the DARL to warn a citizen of Barrow against the unauthorized use of ARL sites. The DARL had good evidence of use by the individual of one of the DEW Line sites turned over to the ARL, and of the ARL wanigan at Teshekpuk Lake and including damage to a weasel. The Alaska State Police and the FBI also were notified. The responsibilities of the DARL were proving broad indeed.

Mention already had been made of the assistance of the ARL to NASA in the establishment of a rocket-launching site two or three miles north of the ARL toward Point Barrow. Two rockets were launched in October 1965—one was an unqualified success and the other was moderately successful.

Also in October 1965, the DARL received a helpful offer of assistance from the University of Washington in repairing and making alterations to the ARL's vessel NATCHIK which had been shipped to Vancouver, Washington, for those purposes. Some of the oceanographers from the university were planning programs that would use the vessel.

By mid-November 1964 attempts were being made for appropriate research programs to be carried on from ARLIS II as it followed its predicted course down the east coast of Greenland. A couple of weeks later arrangements had been made for support of the floating station by using Alert in Canada as a support point. Certain conditions had to be met to fit in with the Canadian schedule, such as scheduling landings at Alert so far as possible on Mondays when the airfield would be available for outside aircraft. By the middle of January 1965 the station was poised off the northeast tip of Greenland about to exit the Arctic Ocean and enter the Greenland Sea on its southerly course. A Fairbanks newspaper in its issue of January 21, 1965 reported that ARLIS II, still being supported from Barrow by the ARL's R4D, was 20 hours from Barrow—so far that two refueling stops were necessary on each support flight.

In early May the station was evacuated, the planning and direction of the evacuation being from Iceland. The people were taken to Iceland after being taken off the ice island. Most of the equipment also was saved

but a few items, including a D-4 tractor, had to be abandoned. The DARL provided the following information about the famous station after its abandonment and up until the end of June 1965. "Since evacuation, ARLIS II had been sighted approximately every 4 or 5 days. On 31 May it was at 65°17'N, 33°35'W and pieces the size of football fields were seen breaking off. On June 4 it was found again and the major remaining piece had split in half. On 20 June it was sighted at 64°14'N, 39°40'W broken into 8 to 12 pieces; the largest piece had the runway on it. During its last days it was noted as rotating 8 to 10 complete revolutions each day. We are very pleased that even in its last days ARLIS II has provided excellent scientific information as it did during its four year life span. It is a very fitting end to the ARLIS II story."

THE RESEARCH PROGRAM IN 1963

The research program for 1963 was the result of individual and institutional planning on the same general pattern as in recent years. As before, part of the program was financed and the projects administered under the ONR-AINA arrangement. In a letter of March 5, 1963 Dr. Britton informed Brewer that a group of 13 AINA projects were approved for the year. The list included 11 returns to the ARL of projects under principal investigators who had been there before. Ten of the projects were in biological fields and three in the social-sciences.

As in 1962, the physical-science program was the result of much planning in government agencies and the making of arrangements, in many cases, with outside institutions or agencies. The ice-island research programs were stepped up, but the total number of physical-science projects was somewhat reduced from 1962.

Research in the Physical Sciences

The number of physical-science projects was 32, down 6 from the year before. Of the 32 the repeaters totaled 18 and constituted the bulk of the program.

Gravity, geomagnetic, acoustic, and seismic studies weighed heavily in the 1963 research program. Eleven projects were involved. Of those, seven were continuations and four were at least partially new studies, three of them under principal investigators who had been or were at the ARL with other or related projects. The seven repeaters included the following:

1. Arctic Basin Acoustic and Seismic Studies, T-3, under Dr. Kenneth Hunkins of the Lamont Geological Observatory. The project was continued throughout the twelve months, with researchers being rotated from time to time. In all, ten men from Lamont were stationed on T-3 at some time during the year.

2. The Arctic Underwater Acoustics project, sponsored by the General Motors Defense Research Laboratories under the leadership of

Beaumont Buck, was active during March and April, with J. W. McClung, also from GM and C. R. Greene and T. J. Tulko from NOL as assistants to Buck. The work was performed largely from a camp set up on the ice 106 miles northeast of Barrow; the camp providing a noise-free environment which was desired for the studies.

3. The NOL project Geomagnetic Investigations in Northern Waters under William Schwendinger was continued from January through October. Neither Schwendinger, nor his successor, Charles A. Rowzee, were present at the ARL. ARL staff members James Corwin, Gary Sides, Ben Harding, and Samuel Johnson took the measurements. The project was in a state of suspension from April to July, awaiting the arrival of an NOL engineer to remove or repair the equipment. The freak storm of October 3 wiped out most of the equipment.

4. Geomagnetic Investigations in the Arctic Basin under Dr. Ostenso was continued also by the flying of 25,720 nautical miles of Aeromagnetic tracks in 149.3 hours of flight time by a Navy P2V-5F (Neptune). Eight Navy men and one Marine carried out the flights which ranged from Barrow to Thule, Greenland.

5. During January, February, and March Ostenso was carrying out his project Geophysical Investigations in the Arctic Basin. Due partly to mechanical problems with the project aircraft, very little was accomplished on the study. Ostenso did, however, have occasion to make arrangements of interest to the following project.

6. Geophysical Investigations—ARLIS II, a gravity and magnetics study, was active throughout the year. Dr. George Woollard, who was listed as project head, was not present. Besides Ostenso, the researchers were D. Jan Black, Jay Hirschman, Richard Davidson, Karl Redell, and William Unger. The group was very active and accomplished results, not only in gravity and magnetics, but also in sub-bottom profiling.

7. The Magnetic Observatory continued its operation through the year, with Willis Jacobs of C and GS again in charge. He received assistance near the end of the year from his successor, Terrance Hardiman, and from James Corwin and Edgar Sparks of the ARL staff.

8. Dr. Victor Hessler of the University of Alaska Geophysical Institute directed Geomagnetic Micropulsation Studies during March to November. The project involved recordings on magnetic-tape. Tapes were sent to the Denver Research Institute for analysis. Rudolph Donke, Lorange Schoenberg, and Edward Gauss assisted Dr. Hessler.

9. During the March-June period, Dr. Ostenso carried on another project involving a Gravimetric Survey of the Arctic Ocean Coastal Reef. He was assisted by Stephen Den Hartog, also from the University of Wisconsin. Jay Hirschman also assisted on the project. In June the personnel moved to ARLIS II to work on a similar project there.

10. Dr. Ken Hunkins also had a second project during August-November, involving Seismic Crustal Studies of the Arctic Ocean Basin.

The project involved personnel from other universities, including Dr. Wade Himes and Thomas Fitch from the University of Minnesota and six men from the University of Wisconsin. Recording sites were set up at Skull Cliff, about 30 miles from Barrow, and at Carol Lake.

11. A new project was carried out by DECO Electronics, Inc., which performed Geomagnetic Fluctuation Studies during June and July. The project was performed by Robert Morgan and Neil Bankert. It involved obtaining data on natural atmospheric noise fields in the VLF and ELF. The four and a half-week study was correlated with similar work done in other areas.

Research in the fields of atmospheric, meteorology and micrometeorology, radiation, and related subjects also accounted for eleven of the 1963 projects. Of those seven were essentially continuations of on-going projects from 1962.

Dr. Phil Church, for example, returned to ARL where he was in charge of two micrometeorological studies. One, on ARLIS II, was a study of sea-ice micrometeorology which continued operation throughout the year with a succession of investigators. They included Charles Cooke, Arnold Hanson, Richard Sommerfield, Peter Witt, Reid Neufer, Ronald Priebe, and Clyde Haglund. Also on a year-round basis the Church investigations in the Barrow area were continued, with participation of Bruce Lieske, Desmond Bailey, John Unger, Leander Stroschein, Quincybelle Smith, Anna Lieske, and Dr. Norbert Untersteiner.

The Naval Electronics Laboratory research on Arctic Environmental Optics, a project headed by John Hood, was concluded in December, with Donald Stephens continuing the field operation.

Similarly the Carbon Dioxide Studies, a University of Washington project under John Kelley, was active through the year, with John Unger and Leander Stroschein of the Church group also giving assistance.

The National Bureau of Standards Ionospheric Research project continued under Alton Crawley. His assistants were Rita Crawley, George Leavitt, John Pitts, Roy Shumaker, and Edmond Violette.

Dr. Victor Hessler returned from the Geophysical Institute to pursue from April through December his Telluric Current Studies, with the aid of Willis Jacobs from the Magnetic Observatory and also of James Corwin and Lorance Schoenberg of the ARL staff.

The Public Health Service project in Radiation Measurements continued through the entire year, with readings being made by ARL staff members assisted by Willis Jacobs.

During October the ARL Radio Station became the object of experimentation and study under Robert Miles, Larry Stinson, and Earl Saulman of the Navy. John Esterbrook of Wien Airlines and James Corwin of the ARL also assisted. For that and other projects at the ARL the October 3 freak storm was a significant factor.

During February and March a team of investigators from the University of California, led by Dr. James Barcus, was at the ARL

conducting Upper Atmospheric Studies (Visual Auroral Activity and Production of X-Rays).

Another project in Ionospheric Sounder Experiments (VLF) was undertaken by a group of four from Aero Astro Corporation. Donald Adrian was in charge. Part of the program aimed to gather information on the lower ionosphere of the Arctic under conditions of continuous sunlight.

Near the end of October John Linnerson, assistant to Professor John Winckler of the University of Minnesota, arrived at Point Barrow for the purpose of preparing for the Polar Circling Balloon Observatory for the International Quiet Sun Year (IQSY) program to be initiated in the spring of 1964. It was found that both Barrow and T-3 would make good sites for tracking stations.

Research on ice and snow was somewhat reduced in 1963. Dr. Carl Benson's Reconnaissance Snow Survey of the Arctic Slope continued during March-June with Emil Peel and Donald Williams in the field.

The Naval Oceanographic Office continued its project of Strain Measurements on Arctic Pack Ice from ARLIS II. Dr. Wittmann again was the project head. The measurements were taken by Charles Senior, Lester Wentz and John Hedges.

Harold Peyton's study of the Structural and Mechanical Properties of Ice was active during two weeks in April. Samples were taken from points 90 miles to 250 miles distant from Barrow.

A new ice study was conducted by a CRREL group under Gunther Frankenstein during January-March. It was a study in Ice Engineering. Tests were made on normal sea ice and on high salinity ice. An ice chipper was tested and load factors were studied on different types of ice.

Only one exclusively oceanographic project was active at ARL. It was a project headed by Dr. Kon Kusunoki from Hokkaide University. He and assistants, Hiroji Fushimi and Akito Kawamura, arrived toward the end of the year to make preparations for the study of Arctic Oceanography on ARLIS II in January 1964.

Geology and geography were represented in 1963 by five projects. One of these was the Geological Survey project Geothermal Studies on T-3, under Dr. Arthur Lachenbruch. The project was carried on for most of the year by Lachenbruch, John Kenelly, B. Vaughn Marshall, and Eugene Smith.

Another continuing project was Dr. Jerry Brown's Frozen Ground Studies, on behalf of CRREL. They were conducted from March through December by a group which included Thomas Bernard, Paul Sellman, Robert Lewellen, J. C. Ogden, Donald Alford, Steven Mock, and Allen Tice.

The Geological Survey sponsored another project on the Geology of the Western Section of the Brooks Range. Project leader Irvin L. Tailleux

and his assistant, Gary Anderson, were in the field during July and August. The Kukpuk River area and also that on Point Hope were investigated.

During August Dr. Charles Carson, of the University of Minnesota, was busy collecting samples for Radio-Carbon Dating of Lake Basin Sequences. He worked alone, taking peat-mat samples from the Barrow and Meade River vicinities.

Larry Wilding and Paul Gersper from Ohio State University made Soil Studies of the Ogotoruk Creek Area," as investigators. The purpose of the study was to determine the disposition of radioactive fission products through various soils.

Research in the Biological Sciences

The biological sciences were more heavily represented in the 1963 program than they had been in 1962. The number of projects was up from 16 to 25. Most of the projects concerned fauna rather than flora, but a number of the latter were included.

The following projects were essentially continuations from projects dating back to 1962 or earlier:

1. Arctic Basin Marine Biology--ARLIS II, a USC project under Dr. John Mohr. Assistants were Ronald McPeak, Delton Shirley, Richard Davidson, and John DeTuerk.

2. **Daily Physiological Rhythms of Arctic Mammals**, Dr. G. Edgar Folk, Jr. of the State University of Iowa, project leader, assisted by Mary Folk, Roger Hedge, Gary Shook, and Carolyn Shook. A 12-month project.

3. **Distribution and Abundance of Tundra Arthropods**, a summer investigation under Dr. Kurt Bohnsack of San Diego State College, assisted by Richard Ashley and Gilbert Challet.

4. **Ecology of Lemmings and other Microtines**, the University of California study under Dr. Frank Pitelka. In 1963 his field assistants were David and Frances Mullen, Richard Holmes, Dr. Henry Childs, Heywood Logsdon and Gary Stevens.

5. **Ecology of Lemming Predators on Banks Island**, a new and broader title for the investigations of Dr. William Maher of Santa Barbara State College. His assistants were Stephen MacLean and Richard Tenaza. This was a summer project.

6. **Environmental Adjustment of Arctic Foxes**, a University of Alaska project under Dr. Fred Dean. David Chesmore did the field research during March.

7. **Integrating Mechanisms in the Pairing of Predatory Birds**, a project under Dr. Thomas Cade of Syracuse University, assisted in 1963 by Ernest Willoughby and Joeb Woods during May, June, and July.

8. **Microbial Metabolism and Soil Fertility in Arctic Soils**, a project sponsored by the Arctic Institute with Drs. William and Josephine

Boyd of Ohio State University as the researchers. They were in the field from April into September.

9. Pedologic Processes Operating in the Arctic Areas of Alaska, the AINA-sponsored long standing project under Dr. John Tedrow of Rutgers. In 1963 he was assisted by E. E. MacNamara, Peter Buell and Grant Walton. Field work went on from May into September.

10. Primary Productivity in Arctic Ponds, a study under Dr. David G. Frey of Indiana University. He was not present at the ARL in 1963, and the field work was done by Jaap Kalff, Robert Shan, and Evelyn Kalff during June-October.

11. Productivity and Nutrient Cycles in the Soil-Vegetation-Animal System of Arctic Tundra, the Dr. Arnold Schultz project. His University of California assistants in 1963 were Rex Pieper, Dr. C. C. Delwiche, Stephen Holland, Glenn Stanley, and Keith Van Cleve. Most of the investigation was done during May-September.

The following projects were initiated during the 1963 season:

1. Arctic Marine Biology—Barrow. It was a second project under Dr. Mohr. The field work was done by Dr. Floyd Durham, Dr. Mikihiko of USC, assisted by James Nageak of the ARL. Investigations continued from August into December.

2. Arctic Vegetation Studies, a CRREL project headed by Dr. Philip Johnson and assisted by John Dennis and Theodore Vogel. The

intensive investigation was carried out during twenty-seven days in July at the Elson Lagoon site. Meter-square quadrants (375 in all) were evaluated "with a seven-point cover scale for association analysis".

3. Cytotaxonomic Study of the Flora of the Ogotoruk Creek Area. The study was by Dr. Albert Johnson of UCLA and Dr. John Packer of the University of Alberta during July and August. The project aim was to collect flowering plant materials for cytological analysis.

4. Ecology of Ground Squirrels, a University of Wisconsin project. No details regarding the personnel or the project are provided in the Progress Reports.

5. Ornithological Collecting on the Arctic Slope of Alaska, a project under Dr. S. Charles Kendeigh, of the University of Illinois, with assistance from William Brooks. Catches of birds were made in the vicinity of Barrow and at Umiat during a ten-day period in August. The purpose of the researchers was to trap birds for experimental studies in bioenergetics. A few were successfully returned to the University.

6. Physiological Investigations of *Dicrostonyx* (pied lemmings), a project headed by Donald S. Farner of Washington State University. William Jacobson arrived at the ARL proposing to proceed to Anaktuvuk Pass to trap the *Dicrostonyx*. Before his planned departure for the Pass, Peter Sovalik arrived from there with 62 live *Dicrostonyx*. Of them 60 were transported successfully to Washington State.

7. **Physiology of Arctic Benthic Forms**, a project directed by Dr. Allan J. Southward of Citadel Hill, Devon, England. He was assisted by Eve Southward and also by Edward Cutler and Jefferson Gonor, of the University of Alaska. The study of the intertidal barnacles at Cape Thompson was carried out during July and August. An attempted trip by boat (the IVIK or the NATCHIK) was unsuccessful due to sundry mechanical and weather problems as well as the heavy ice.

8. **Ptarmigan Studies**, a project under Dr. Laurence Irving, assisted by Leonard Peyton and Y. C. West, all of the University of Alaska. The field trip to Umiat and Anaktuvuk Pass was completed during October-early November and several ptarmigan were found at both places. It was mainly a migration study.

9. **Skeletal Physiology of Arctic Fish and Marine Invertebrates**, a study under the leadership of Dr. Melvin Moss of Columbia University, assisted by Alfonso Solimene. Skeletal remains of marine invertebrates were collected off Point Barrow and from Elson Lagoon and other places. The materials were shipped to New York for processing and analysis.

10. **Studies on Crustaceans of the Genus Mysis and on Freshwater Tubellarians**" (Arctic relatives of certain marine glacial relicts). The investigation marked the return after a year of Dr. Charlotte Holmquist from Riksmuseum, Stockholm. She was assisted by Laurence Schoenberg and Peter Sovalik of the ARL in collecting samples from eighteen

freshwater lakes and twelve marine localities. The samples "were examined for possible occurrence of the crustacean *Mysis relicta*; the freshwater localities for tubellarians as well . . ." It was an AINA-sponsored project.

11. Studies on the Anaerobic Bacterial Flora of the Lemming Caecum, a project under the direction of Dr. Richard McBee of Montana State College. The field investigation, July to September, was carried on by John Johnson. The study involved the taking of caecal material from lemmings and culturing it in different media for eventual chemical analysis.

12. Study of Arctic Mosses, a project of Dr. William and Dorothy Steere of the New York Botanical Garden, was also a renewed study after a one-year interruption. The field work was accomplished by flying to several sites north of the Brooks Range and into Inuvik on the Mackenzie River to collect mosses. They were then dried, sorted and catalogued. The studies were related to previous searches carried on out of the ARL by Professor Hultén of Stockholm University and added further to the knowledge and classification of mosses in the circumpolar North.

13. Study of Freshwater Diatoms was another project carried out by a Scandinavian, Dr. Niels Fogel, of Katedralskole, Odense, Denmark. Samples were taken from the lakes and ponds in the vicinity of Barrow, from the Meade River area, Umiat, Anaktuvuk Pass, Kuk River, Inaru

River, Sagavanirktok Lake, Ogotoruk Creek, and other areas. A total of 375 diatom samples was collected from 265 localities. Fogel reported that "Colorimetric pH determinations were started on 130 of them."

14. A Survey of Whales in the Barrow Area was conducted by Harry Groom of the Fish and Wildlife Service from May 13 to June 6. The Air Force, Anchorage Daily News, and the National Geographic Society also were behind the assignment. Groom joined an Eskimo whaling crew on the ice for 14 days. The results were mainly 1700 color exposures showing techniques employed by the Eskimos in their pursuit of the bow-head whale. Although many whales were chased, none were killed, although two were shot. Groom stated his intention to return.

Research in the Social Sciences

Social science projects numbered seven. Only two were repeats.

One of them was the Archeological Survey of the Noatak River by Edwin Hall, John Scully, and Richard Morlan of Yale University. Field work was done during the three summer months. Excavation work uncovered a mixed collection of artifacts. Remains from a late prehistoric culture were found and studied.

The other continuing project was that of Wayne C. Hanson for the General Electric Company and the Atomic Energy Commission titled

Terrestrial Ecology—Radioactivity in Northern Alaskan Eskimos. Again body counting of Barrow residents was carried on (160 natives and 20 non-natives were examined), and the results showed a slightly higher average body burden than in 1962.

The five new projects included the following:

1. Climatic Attitudes and Sensitivities of Eskimo and non-Eskimo in the Barrow Region of Arctic Alaska. The study was carried on by Dr. Joseph Sonnenfeld of the University of Delaware during September-December. Through the use of thermographs coupled with the use of questionnaires (for which Peter Sovalik acted as interpreter) information was collected on the attitudes of the natives. For comparative purposes a questionnaire was also given to Vinnell Corporation personnel. Various other tests were used to determine environmental perception and preferences. The study involved the Barrow, Wainwright, and Anaktuvuk Pass areas.

2. Cultural History and Ecology of the Central Brooks Range, a project performed by Dr. John Campbell of George Washington University, assisted by Richard E. Morlan. The investigations were carried on mainly in the Bettles area, but also in portions of the lower ninety miles of the John River valley. Ornithological, botanical, and mammalian specimens were collected and recorded. Dr. Campbell, on completion of the field work in June, reported that he was "most pleased with the results of the season".

3. Pre-Pleistocene Fossil Vertebrates in the non-Marine Tertiary of Alaska was a study, by Dr. John Dorr of the University of Michigan, which had been supported also by the National Science Foundation in 1961 and was again in 1963. Douglas Peacock assisted Dorr in 1963. However, extensive and intensive field search in the Franklin Bluffs area on the east side of the Sagavanirktok River produced negative results. Neither vertebrate nor invertebrate fossil materials were found.

4. Physiology of Arctic Survival, a study by a group from Stanford University under the direction of Dr. Terence Rogers, was performed under an Air Force contract. The small study carried out during April aimed at collecting data on how a survivor (of an airplane crash for example) would conduct himself in order to best meet the strains which might restrict survival chances.

5. Zoonotic Disease Investigation was a project carried out by Dr. Robert L. Rausch of the Arctic Health Research Center. June 7-19 was utilized by him and his assistants, Francis Fay and Dr. Curtis Newcombe, to determine the status of microtine populations. The information, it was thought, would be useful in planning for later field studies on certain diseases, "especially alveolar hydatid disease and rabies, which involve foxes or microtine rodents."

Other Projects

Two photography projects were carried on during 1963. One of them was the Lowell Thomas, Jr. ARL Photography project for the

National Geographic. It was performed during May and June. Another photographic operation was carried out by the Navy on ARLIS II, under the direction of Billy Norman. It was done during September to November. The purpose was to document activities on the island for Navy uses.

Summary of the 1963 Program

As already noted, the ice-island research program was stepped up in 1963, particularly on ARLIS II. Projects there were carried on by Mohr in marine biology, Kusunoki in oceanography, Woollard and Ostenso in geophysics, Church in micrometeorology, and Wittmann in strain measurements on pack ice. The T-3-based projects were Kenneth Hunkins' acoustic and seismic studies, and the geothermal studies directed for the Geological Survey by Arthur Lachenbruch.

The following table shows the monthly range of numbers of active projects and of investigators working at or out of the ARL.

<u>Month</u>	<u>No. of Projects</u>	<u>No. of Investigators</u>
January	15	25
February	16	32
March	23	58
April	25	60
May	35	51
June	35	83
July	39	93
August	36	71
September	27	73
October	24	65
November	22	58
December	19	34

In all there were 66 active projects. There were 230 investigators who worked out of the ARL. Twenty-five universities were represented plus a Danish school and a Swedish national museum. Included in the 25 was one Canadian (Alberta) and one Japanese (Hokkaido) university.

More of the principal investigators were present in 1963 than in the year before. The shift in research emphasis was notable mainly in the heavier concentration of projects dealing with biological sciences. Oceanographic research was less than in earlier years, with Hokkaido University having the only project in that field.

By and large the investigators appeared to be pleased with their progress during the shorter or longer pursuit of their research aims. Researchers swarmed all over the area north of the Brooks Range and even spilled over into the northwestern parts of Canada. Again there was a near balance between the number of new and old projects. In some instances (Dr. Steere, Dr. Holmquist) principals returned to the ARL after being absent the year before.

THE RESEARCH PROGRAM IN 1964

A new look at the arctic research program, including that portion functioning out of the ARL, was taken in September of 1963. A group of nineteen, including 5 Canadians, participants from ONR, AINA, and others from the Weather Bureau, other Navy offices, the Army, the Rand

Corporation and the U. S. Steel Foundation, visited several northern stations, among them the ARL. The findings and conclusions of that highly competent group were released in March 1964 as a Report of the 1963 Arctic Research Review Group.

The report, which ran to 29 pages, contained comment on many aspects not relevant here, but significant portions concerned the ARL research program.

One conclusion reached was, "that in most disciplines of military significance the amount of research is not large enough to reflect the military requirements of this strategically vital area. . ."

The problem of research was described as one of finding answers to two main categories of questions: 1. how does nature work, and 2. how can we use this natural process? In relation particularly to military needs, emphasis was placed on the "truth that complete knowledge of the environment is essential. . ." Present knowledge of the Arctic, contended the report, "is very inadequate". Among the subjects on which greater knowledge is needed, said the report, is "the energy balances between the Arctic Ocean and its inlets and the atmosphere"; also vital is "a thorough knowledge of the physical aspects of the Arctic Ocean"; also weather, the varied environmental conditions unique to the Arctic, magnetic storms and other phenomena which create special problems.

A section of the report which described the operation of the ARL referred to the site as "offering opportunity for research on many

uniquely arctic problems such as: Arctic environmental factors as related to man's work and survival, auroral phenomena and their effects on radio propagation and geomagnetism, oceanography, arctic meteorology, and physiology of arctic life." The importance of the ice islands, ARLIS II and T-3, was stressed as offering opportunities for research in "ice, heat budget, physical oceanography, meteorology, geomagnetism and upper atmospheric physics".

The report quoted with approval a statement of Dr. A. P. Crary in a report by the Committee on Polar Research, in which he stated that, "To date most of the U. S. efforts in the Arctic Ocean Basin have been limited to necessary descriptive geophysical works, and although only a small fraction of this has been accomplished, more emphasis should now be placed on basic scientific programs that are unique to the Arctic or that can be more easily solved in the Arctic Basin." The Review Group found that only at the ARL and its satellite stations could a reasonably balanced program be found.

The report, finally, contained a section of Recommendations, based on the "extant lists of requirements for arctic research and framed in accordance with the experiences of the Group's trip and the requirements of this report". The outlined recommendations included the following:

- I. Drifting stations. T-3 and ARLIS II should be maintained. Additional permanent drift stations should be established and should be spread widely throughout the Arctic Basin.

Scientific programs at the stations should include:

1. Determination of the "life cycle" of the polar pack, the dynamics of its movements, and its distribution in time and space;
 2. Bathymetry and structure of the Arctic Basin;
 3. Observation of the character and movements of the waters in time and space;
 4. Study of living populations, especially the pelagic and bottom fauna;
 5. Core sampling, to study the history of the ocean and the climate;
 6. Geology of the bottom;
 7. Meteorology;
 8. Aurora observations and other upper atmospheric matters;
 9. Underwater acoustics;
 10. Ice physics and engineering properties of sea ice; and
 11. Heat-balance studies.
- II. Ionospheric and upper atmospheric research, specifically wave-propagation studies, sampling of the physical and dynamic properties of the atmosphere, especially by the extension of the synoptic rocket network in order to sample the regions up to and above 30 kilometers.
- III. More emphasis to installation of seismic, gravity, and magnetic equipment.
- IV. Further research on permafrost.

- V. Study of psychological responses to cold and adjustments thereto.
- VI. Physiological effects of arctic environments and programs of training and preparations need continued study.
- VII. Research on ablation control.
- VIII. Continuity in research programs in order to gain maximum value and to obtain trained scientists and a steady flow of new scientists.

The Program

The 1964 research program was again a combination of arrangements made by ONR, other government agencies, universities, and the Arctic Institute. The Arctic Institute part included a dozen projects based at the ARL, most (9) of them in the biological sciences. Of the principal investigators, nine had previously led projects at the ARL. The Rutgers soil-study group under Dr. Tedrow in 1964 did field work in northern Canada and was not based at Pt. Barrow.

The physical sciences

Again the physical sciences supplied most of the projects—46 of 78, or 59 percent of the total number. This was 14 more than in 1963 and was, in fact, the largest physical-science program the ARL had serviced. More than half of the projects (25) were essentially repeaters or continuations from 1962 or 1963.

Gravity, geomagnetic, acoustic, and seismic studies again were represented heavily by nearly a third of the physical-science projects

(14 of 46). The repeaters included:

1. Arctic Basin Acoustics and Seismic Studies under Hunkins of Lamont on T-3. Dr. Hunkins was not in the field.
2. Underwater Acoustic Research in the Arctic Ocean—T-3 under Beaumont Buck of General Motors Research Laboratory.
3. Geophysical Investigations—ARLIS II and Geomagnetic Investigations in the Arctic Ocean, both directed by Ostenso of the University of Wisconsin.
4. The Magnetic Observatory continued to operate under the C and GS with a succession of station leaders, Terrence Hardiman, John Townshend and Patrick Clark. Marvin Carlson was there in August. James Corwin of the ARL staff also assisted.
5. Geomagnetic Micropulsation Studies in Barrow were continued under Dr. Victor Hessler, and Dr. Ostenso also continued his Gravity Survey of the Arctic Basin.

Among the new projects which operated in 1964 were three in the field of magnetics and three in the gravity field. These were:

1. Dr. Hunkins' Airborne Investigation of Magnetic Regional Gradients in the Canada Basin, another Lamont project, carried out in the field by Ralph Shaver, who arrived at Barrow on September 28 and began setting up a magnetometer for pre-flight testing.

2. During July and August a Geophysical Institute project under Dr. Eugene Wescott, assisted by Ronald Fowler, studied Effects of a Coastline on Telluric Currents and Magnetic Variations. Three field sites were set up at different distances from the coast, and the results were then compared with the recordings at the Barrow Observatory.
3. One of the purposes of establishing the temporary camp on ARLIS III in February was to permit further magnetic investigations in that area. The investigators were Hessler and his assistant Daniel Swift. Recordings were made during March. The aim was to collect data on a number of magnetic storms. That was accomplished successfully. The study could not be accomplished on T-3 or ARLIS II because of the depth of freshwater ice on those ice islands. ARLIS III was on an ice floe.
4. One of the three new gravity studies was financed by Air Force Cambridge Research Laboratories and administered by the International Gravity Commission. The investigators were Dr. Ivan Gough and Mrs. Gough from the Graduate Research Center of the Southwest at Dallas, Texas. The project was titled Gravimetric Observations at ARL with the Cambridge Pendulum Apparatus. The pendulum apparatus was from

Cambridge University, England. It was installed in Building 251 and observed during from July 27 to August 5. The same equipment was used at several locations from Barrow to Great Falls, Montana.

5. Dr. David Barnes of the Geological Survey returned to the arctic slope to conduct a Gravity Survey of Northern Alaska. His assistant, Rex Allen, established 92 stations during April and an additional number during May brought the total to nearly 150. Elevation control was reported to be excellent.
6. Another gravity project which dated back several years was the 4-day gravity measurement at the ARL by Richard Heidemann and Richard Longfield of the University of Wisconsin for Dr. George Woollard. This was part of the World Wide Gravity Survey by the Air Force Cambridge Research Laboratories.

In 1964 the fields of atmospheric, including meteorology, micrometeorology, radiation, and other related subjects occupied the attention of thirteen projects. Of these, seven were continuations from 1962 or 1963.

Dr. Phil Church continued the two investigations in micrometeorology, one on ARLIS II and one at Barrow. John Kelley, also from the University of Washington, continued his study of Atmospheric Chemistry, with the field assistance of Leander Stroschein. It was a year-round atmospheric sampling project. Alton Crawley and his group from the National Bureau

of Standards continued, also on a 12-month basis, the Ionospheric Research Project.

The All Sky Camera for IQSY, set up at the end of 1963 by Dr. Hessler, was in operation during January-April. The film was sent to the Geophysical Institute for developing and printing and for distribution to the IQSY data centers for aurora.

The PHS project Radiation Measurements under Jay Silhanek was in continuous operation. Readings were taken mainly by James Corwin of the ARL.

Another IQSY related project, the Polar Circling Balloon Observatory under the direction of Dr. John R. Winckler of the University of Minnesota was active from January through to August, with an interruption during April-June. The balloons released from Barrow during February-March did not go into polar orbit, so a switch was made. The July launchings were made from northern Norway. Balloon failure at different altitudes resulted "in very little useful data for IQSY" reported Bob Nelson for Dr. Winckler in July, at the end of the launchings.

Six new projects in 1964 included the establishment of a micro-meteorological team on T-3 by Dr. Church.

Included also was another auroral study on T-3 and at Barrow by a University of Alaska group under Dr. S. Akasofu. Field work was done by Steven Young and William Stringer during August and September. The

project was related to and essentially a development from Dr. Hessler's IQSY all sky camera studies.

During June a group from the FAA, Anchorage, was at the ARL to choose a site for an antenna for VHF/UHF air to ground communications. Cyril Brewer, electrical engineer, was in charge of the three-man party.

During July a Naval Communications team under LTJG Lawrence Edmundson arrived and continued operations during August and September.

Between July 28-August 11, a CRREL study under Dr. Motoi Kumai and Harold O'Brien took "condensation nuclei counts" in various locations. The project was titled Studies of Fog Formation and Nucleation in the Vicinity of Point Barrow. The count was found to be about of the same order as for Thule, Greenland.

In July a NASA representative, Germain Brown, visited the ARL to discuss the design of a rocket facility to be built near the Laboratory. A site was chosen and construction was underway in September. The purpose of the rocket launching program was to reach the upper atmosphere for the gathering of meteorological information. Preliminary tests and location of microphone sites indicated no unsolvable problems.

Ice and snow research in 1964 involved seven projects, of which three were new. The repeaters included:

Drift Station Ice Strain Studies—ARLIS II, the NAVOCEANO project under Walter Wittmann. He was assisted by Charles W. Senior and

Robert Landis in spring and fall programs during April and September-October. By erection of "towers" (long poles with strips of colored bunting attached) arranged in grid fashion, relative movements of the ice were determined by taking daily bearings with theodolites.

The CRREL project Ice Engineering, directed by Guenther Frankenstein was active during February by modification and further testing of the CRREL ice chipper. Equipment was then shipped to Fairbanks.

Harold R. Peyton of the University of Alaska was at the ARL during May to continue his study of the Structural and Mechanical Properties of Sea Ice. He gained further data tending to confirm earlier findings regarding crystal orientation and also acquired new data.

The fourth repeater was Carl S. Benson's Reconnaissance Snow Studies on the Arctic Slope of Alaska. The project was under an NSF grant. Measurements and profile studies were made during March and again in May at different north-slope locations. Donald Grybeck assisted Dr. Benson.

Among the new projects was another NAVOCEANO study, also directed by Dr. Wittmann, termed Arctic Basin Airborne Remote Sensing, the so-called Project ABARS I at ARLIS II. This was the first in an anticipated series of sea-ice remote sensing flights over the Arctic Basin pack ice. The flights were made during April 1-16. The airborne

sensors included an infrared scanner, a CA-8 vertical camera, and two experimental wave-height recorders. One of the purposes of the project was to evaluate airborne sensors for sea-ice investigators. The collected data were returned to the Patuxent River home base.

ARLIS III provided a place from which to carry out a study of Sea Ice Physics, a project directed and supervised by Dr. Kenneth Bennington of the University of Washington. He was assisted by Michael Kuhn. Corings from the ice floe permitted comparisons of old and newer ice. Chemical and other ice-composition analyses were conducted during the February and March occupation of ARLIS III.

The third new project was arranged by Michael Bilello for CRREL during July. The project involved the taking of weekly ice measurements near Barrow Village. Charles Edwardson, Jr. undertook to do this.

Geography and geology again were represented heavily in the 1964 program. Five projects were continuations or repeaters, and six essentially new projects were undertaken.

Dr. Lachenbruch's Study of Heat Flow in the Arctic Ocean Basin was again functioning on T-3 for the Geological Survey. Activity continued from February through September, with Keith Munroe, Eugene Smith, and John Kenelley from the Geological Survey conducting the field measurements by means of water-temperature profiles and in other ways.

The CRREL project Frozen Ground Studies under Dr. Jerry Brown was active from March to September, with the assistance of seven men. During the early months the procedure mainly involved corings and analyses of core samplings. The summer program also involved the activation of a watershed study, ground temperature observations, and thermal erosion work.

The GS project Geology of the Western Section of the Brooks Range under Irvin L. Tailleir was continued during June, July, and August. He had four assistants in conducting the field survey in the Cape Thompson and Pt. Hope areas.

Soil Studies in the Ogotoruk Creek Area also were resumed during the summer by Paul Gersper and his assistants, Marvin Wahrlman and Larry Wilding, also from Ohio State University. During July 20 to September 10 numerous soil samples were collected and analyzed for determining strontium 90 in soil and plants, as well as for gamma-emitting radioisotopes and other related chemicals of soils and selected plants.

During August 23 to September 1, Dr. Charles E. Carson of the University of Minnesota was at Barrow taking samples on four nearby lakes and "mapping basin sequences on a one-foot interval", as part of his continued Investigation Into the Age of Several Lacustrine Cycles in Northern Alaska. That was an AINA-supported project.

The new projects included a study of the Morphology of Arctic Coasts and Deltas by Dr. Harley Walker, assisted by Wayne Lampa, of Louisiana State University. The study made of the Colville delta during June involved examination of stations set up three summers earlier and the collection of sediment samples and cores for later analysis.

Another CRREL project was active from April to August on a study of the Nature and Distribution of Clay on the North Slope and Coastal Areas of Alaska. Dr. Duwayne Anderson was in charge of the project. He was assisted by Allen Tice and PFC John Presley. Investigations were made principally in the Umiat area along the Colville River. Samples were taken for further study, but the August report by Anderson stated that, "It is quite clear from this reconnaissance that building any major roads or railroads in the foothill province of the Brooks Range would require the stabilization of the extensive clay and shale outcrops."

After a long absence from the ARL, Dr. Keith Hussey of Iowa State University returned with a project in July to conduct a Photographic Study of the Exposure Along the Sea Cliff Between Barrow Village and the Will Rogers-Wiley Post Monument. Dr. Hussey was not present, and the project was carried on by John Boellstorff. The purpose, as stated, was "to study the Gubic formation (Pleistocene) which is exposed in the sea cliff . . . in the hope of gaining a knowledge of its environment of deposition." Samples were collected and sections were made along the

stretch of coast under study. Tentative conclusions were reached, to be tested by further laboratory work.

The storm of October 3, 1963 brought Dr. James D. Hume of Tufts University to Pt. Barrow in June, 1964 to study the Shoreline Changes Near Barrow caused by the storm. He was assisted by Donald Biederman and also by Patricia Hume. His project was supported by the AINA. Extensive mapping and comparisons with earlier profiles (1962) were completed. He reported in August that the flood line showed that the high-water mark during the storm had been about 11.5 ft. above sea level.

Another soil survey for strontium 90 was conducted during July by Samuel Reiger and William B. Oliver for the Department of Agriculture under contract with the AEC.

Finally, included in this group was the Aerial Photography and Topographic Mapping of Barrow, carried out by Aero Service Corporation for CRREL. The project was directed by David Raymond and was completed during July. A one-half meter contour map was produced. Aerial photography also was undertaken, and a "separate area was filmed in Kodacolor and infra-red for study purposes."

Oceanography was the objective of two projects in 1964. One of these, under Dr. M. J. Dunbar, was essentially a biological study and it will be included under that heading. The other project, which was a continuation from 1963, was the Hokkaido University project Arctic

Oceanography, ARLIS II, under Dr. Kou Kusunoki. His assistants in 1964 were Kasuo Fujino, Hiroji Fushimi, Akito Kawamura, and Takashi Minoda. Studies were made of water samples, internal wave action, chlorophyll analysis, phytoplankton cell count, temperature distribution, and many chemical analyses for a variety of purposes.

Biological sciences

Of the 78 projects in 1964 the biological sciences accounted for 23, or about 30 percent of the total. Of them 15 were repeaters from the year before or from earlier years. Of the 23 projects, 9 were AINA supported. The continuing or repeating projects included the following:

1. An Archeological and Ethnological Investigation of the Historic and Late Pre-Historic Periods in the Noatak River Region, Northern Alaska. The project was carried on in the field by Edwin S. and Leona Hall of Yale University. During June to October the Halls lived and worked in the area of the Noatak Eskimos collecting artifacts and observing their ways of life. More than 1500 artifacts were recovered in the Kanguiksuk site.
2. The Arctic Basin Marine Biology studies at ARLIS II under Dr. John Mohr of USC continued to operate through the year, with Henry Genthe, Jr., John De Tuerk, Ross Wilcox, and Kris Moser as field workers. Plankton and water sampling provided much information on "dominant genera", production at different

levels and other types of information. The Mohr group shared the hydrohut with other researchers such as the Hokkaido University group.

3. The other marine biology project, pursued also by Professor Mohr, was at Barrow. Sampling of fresh-water lakes in the Barrow vicinity produced a variety of information, including data on salinity at various depths and under various conditions of melting and run-off.
4. Dr. Charles J. Smiley, from the University of Idaho, returned to the ARL after a three-year absence to pick up a Continuation of Studies of Stratigraphic Paleobotany in Northern Alaska. During June-August he was assisted by Richard Biggerstaff, Donald Hartman, and Donald Jennings, also from Idaho. Fossils were collected along the Chandler River during July, and on the Colville River during August. The project terminated on August 11 at Umiat. Back at the ARL about 750 lbs of fossils were crated for shipment and field notes were organized before departure of the party.
5. The Cytotaxonomic Study of the Flora of the Ogotoruk Creek Area under Dr. Albert Johnson of the University of California, was active in the Cape Thompson area during July 18 to 29. The objectives, as reported, were "a better understanding of

the taxonomic, phytogeographic, and ecological relationships of Arctic plants." Plant materials were collected for field-laboratory and for later analysis.

6. Dr. G. Edgar Folk, Jr. and Mrs. Folk were again at the ARL continuing their study of Daily Physiological Rhythms of Arctic Bears, Canidae and Other Mammals. Others from the State University of Iowa who assisted on the project were William Ashlock, Roger Hedge, plus Carolyn and Gary Shook, who were forced to leave, due to illness of Mrs. Shook. The use of temperature capsules under the skin of the animal was continued. Ashlock devised very small capsules and also an inexpensive and routine method of recording body temperatures from radio capsules. Wolves, foxes and a marmot were used, and later grizzly bears also.
7. Dr. Kurt K. Bohnsack from San Diego State College was at the ARL during June-July continuing his research on the Distribution and Abundance of Tundra Soil Arthropods. As reported, "field work was mainly devoted to mapping the micro-topography of the transect study areas." A considerable number of sod samples also were collected in order to get living mites for life-history studies. Arthropods also were removed from sod samples taken by Dr. Jerry Brown of CRREL in April.

8. A University of Wisconsin three-man group consisting of Dr. William Reeder, Dr. Herbert R. Melchior, and Greg Streveler was again involved in a study of the Ecology and Behavior of Arctic Ground Squirrels. Success was reported on a study of factors controlling success or failure of hibernation, habitat selection, dispersal of young squirrels, and on hoarding and foraging behavior. The field season was June 12 to September 11 at the base camp on the Kukpuk River, about 15 miles inland from Cape Thompson headquarters.
9. The Ecology of Lemmings and Other Microtines in Northern Alaska again was the object of study by Dr. Pitelka and his team from the University of California. The field researchers included Richard Holmes, H. Steven Logsdon, Stephen MacLean, Gary Stevens, and David and Frances Mullen. The study of lemmings was supplemented by the observation of predators, such as birds, in the Barrow area.
10. Dr. Eric O. G. Hultén from Stockholm returned in 1964 after a three-year absence to pick up his Field Studies of Certain Groups of Arctic Flora. He arrived on July 30 and proceeded to Noatak and Ogotoruk Creek and later to Inuvik, NWT for the purpose of making his collections of arctic flora.

Before the end of August he had visited many other localities and had collected "very interesting and special flora."

11. Another Swede, also from the Museum in Stockholm, Dr. Charlotte Holmquist, also returned during July for a period of intensive sampling in her Further Field Studies on Crustaceans of the Genus Mysis and on Fresh Water Fauna. Both marine and freshwater sampling was done in 25 localities.
12. Dr. William Boyd and his wife, Dr. Josephine Boyd, returned from Ohio State on a study of Microbial Ecology of the Inuvik, NWT, Canada Area. The Inuvik Research Laboratory was used as a base for processing and analyzing samples. In addition to soil studies, samples were taken in five lakes and in the Mackenzie River. The project was carried out in close cooperation with the Canadian Department of Agriculture at Fort Simpson.
13. Dr. Laurence Irving continued his Physiological and Migration Studies of Ptarmigan from March through September. He was assisted by Dr. George West, Clayton White and Leonard Peyton. The purpose of the summer's field work was to capture adult and juvenile willow ptarmigan and maintain them in captivity for shipment to College, Alaska; this for the purpose of acquiring metabolic data and the quantity of food

consumed at various temperatures in order to determine energy requirements. Birds also were captured and banded, and others were shot for analysis of crop contents, plumage changes, fat composition, and other data.

14. The study of Primary Productivity of Arctic Ponds by Dr.

David Frey of Indiana University also was continued. Field work was done by Jaap Kalff and Michael Miller. Algae production and other data concerning arctic ponds were collected and peaks of production were noted during that dry summer.

15. Finally, among the repeaters was the Dr. Arnold Schultz

project on Productivity and Nutrient Cycles in the Soil-Vegetation—Animal System of Arctic Tundra, another University of California summer project. Dr. Schultz was assisted in 1964 by Stephen Holland, Siegfried Wantrup, and Keith Van Cleve. Dr. Schultz departed on July 9. Grass and soil samples were taken and processed; general "observations were made on permafrost and thaw, litter temperatures, etc." In addition, fertilized plots were re-fertilized, and subsequent samples taken. Decomposition studies also were made.

New biological projects included the following eight, some of them by principals who had pursued other projects at the ARL.

1. One of them, related in some respects to Dr. Folk's study, was the study of Circadian Patterns in Arctic Microtines Exposed to Environmental Extremes by Dr. Richard V. Andrews of Creighton University. The experiments were conducted during August to test for 24-hour periodicity in cultured adrenal tissue from arctic rodents. Preliminary analysis indicated that all species examined showed adrenal circadian patterns. The patterns were evidenced by high glandular respiratory activity during the morning hours and lower rates during the evening hours.
2. Dr. Henry E. Childs, Jr., of Cerritos College was assisted by Richard Tenaza in a study of Comparative Behavior of Arctic Microtine Rodents with Emphasis on Aggressive Behavior, Especially in the Brown Lemming. Work was done principally at Barrow and at Lake Peters during July. Use was made of the animal house at the ARL, and recordings were made of behavior patterns, principally by photography. At Lake Peters numerous specimens were taken of birds and other animals, in all 24 species of birds and 9 species of mammals.
3. Another CRREL project functioning at the ARL was led by Dr. Philip L. Johnson, Evaluation of Vegetation Dynamics and Frost Action of Frost Boils. John Dennis and Robert Funsch

assisted him in this June to September study. The project involved a "program for assessing phenology and root production". Instrumentation was prepared and used for measuring plant photosynthesis and respiration. Photographic surveys also were made.

4. Another new summer project was led by Dr. Hiroshi Meguro of Tohoku University. He and two assistants, Kuniyuki Ito and Yoshiyuki Tsuru, were engaged in a project Studies of Plankton in Ice in the Arctic Ocean Near Barrow, Alaska. One of the aims of the project was to compare the situation near Barrow with that reported for Antarctica. The findings of the Meguro investigations during July and August were that the arctic ice off Barrow had "a far more complicated structure than ice in the Antarctic." Thirty ice samples were stored under refrigeration. Further interpretation of data awaited analysis in Japan.
5. A study with related interests was underway from May to September on ice island T-3. The project was under the direction of Dr. Max Dunbar, of McGill University, with Garth Harding and Martin Weinstein as the field researchers on a Study of the Physical and Biological Oceanography of the Area Occupied by T-3. The operation involved plankton

hauls from various depths by cooperation with the group from Lamont (Dr. Hunkins) and by the sharing of the use of the Lamont winch. Hauls were made from several hydrostations. Because in practice the project involved plankton studies, it is included with the biological projects.

6. The Alaska Fish and Game Department sent John J. Burns to Barrow during August "to acquire specimens and biological data pertaining to the Department's studies of walrus and bearded seals". Arrangements were made to acquire specimens, primarily from hunters in Wainwright.
7. During July the Agricultural Experiment Station at Palmer, Alaska, sent Dr. Harlow J. Hodgson and Roscoe L. Taylor to Pt. Barrow to do Taxonomic Studies of Arctic Grasses and Legumes. Collections of live root material of grasses and legumes were made, also living specimens and seeds, at Barrow, Meade River, Umiat, Icy Cape, and Cape Beaufort. Experiments on the arctic grasses and legumes were to be continued on experimental plats and in greenhouses in Palmer.
8. The October roll of projects in action listed one under Dr. John Mohr of USC called Whales and Lakes Project. The study was carried on by Floyd E. Durham and was related to the Arctic Basin Marine Biology—Barrow studies.

Social sciences

The social sciences again ran a weak third in numbers of investigations. Seven projects were in this category, four of them were continuations.

1. Dr. Joseph Sonnenfeld from the University of Delaware continued his Climatic Attitudes Studies into January among the Eskimos at Anaktuvuk Pass. Further testing at the Barrow school and in Barrow village and among various groups in the Camp was completed before Dr. Sonnenfeld's departure January 15.
2. The study of Radioactivity in Northern Alaskan Natives and their Foods was continued through 1964 by the group headed by Wayne C. Hanson from the General Electric Co. (Hanford Atomic Products) at Hanford, Washington. Body counts and tests of samples of lichens permitted comparisons with earlier counts and also gave information on seasonal variations. Hanson was assisted by Les Braby, H. Earl Palmer, Paul Chernich, Bobby Griffin, and Donald Watson.
3. The third continuing project was that of Dr. Robert Rausch from the Arctic Health Research Center, whose team of three, headed by Ronald Skoog of the Alaska Department of Fish and Game, spent a week in April evaluating the significance of brucellosis in the caribou of northwest Alaska and investigating

the occurrence of foot rot and other diseases in that population. It was part of the Zoonotic Disease Studies initiated earlier by Dr. Rausch.

4. During July-August Dr. Paul Jensen from Oregon State University was at the ARL to tape commentaries and prepare other educational television material to be used by the federally supported Channel 10 at Portland, Oregon. Two of the arctic programs were to be used by HEW during the school year 1964-1965. Recorded coverage included research projects in story and pictures, in the laboratories and in the field. Parachutes at T-3 and ARLIS II also were covered.
5. Another returning project was that sponsored by the Arctic Aeromedical Laboratory on the Physiology of Arctic Survival. Frederick Milan was the leader of a group of military personnel, plus Richard Nelson from the University of Wisconsin, who accomplished the field work at the village of Wainwright. Most of the information obtained was gathered from Eskimos and others living in the Wainwright area, by conversation, and by direct observation of living habits, clothing, and of the economy of the people. Nelson reported most strongly his satisfaction with the choice of the Wainwright area for making his study.

6. During May and June Dr. Laurence Irving from the University of Alaska and Dr. Per Scholander from the Scripps Institution of Oceanography carried out a study of Ultraviolet and Visible Radiation Through Components of the Eyes. Assistance was given by several others from Scripps and by Dr. Kristian Anderson from the Institute of Aviation Medicine, Royal Norwegian Airforce. Progress was reported by Dr. Scholander in gathering "clues as to what makes the Arctic animals so resistant to ultraviolet. Umiat was found to be an excellent location for the study.
7. Listed as a separate project in the October monthly list of investigations was one called Alaska Eskimo Exploitation of Sea Ice Environment under Dr. William S. Laughlin of the University of Wisconsin, with Richard K. Nelson as assistant. It was a segment of the research being done by Nelson in the Wainwright area summarized above.

Other Projects

In addition to the foregoing 76 projects there were two activities not clearly identifiable as scientific investigations. One was the Lowell Thomas project of gathering material on the arctic research story for the National Geographic Magazine. He and Ted Spiegel spent considerable

time during March-April and July-August in collecting picture coverage at several places as well as material for the story.

During late July and early August a group of architects, engineers and consultants, headed by Leslie Rogers, representing the firm of Gray, Rogers and Osborne were at the ARL to design a new ARL building. They also made a flight to Inuvik. Harold Peyton from the University of Alaska was one of the group. The existing facilities were surveyed, the location was viewed during the thaw period, and the new construction was planned. The trip to Inuvik was for the purpose of viewing the new laboratory there and to learn of engineering practices in the newly constructed arctic town.

Summary of the 1964 Program

A few statistics will indicate something of the size and scope of the 1964 program, which was the largest to that date:

- 78 projects operated at or out of the ARL
- 27 universities, colleges, and other educational institutions, plus the national historical museum of Stockholm, were represented by the investigators.
- 15 government agencies or services (including one Norwegian) were represented.
- 6 companies operated under government arrangements.

The subject matter of the 78 projects was roughly classifiable as follows:

- 46 in the physical sciences, including 25 repeaters or continuations,
- 23 biological science studies of which 15 were repeaters,

7 social science studies of which 4 were continuations, and 2 miscellaneous projects of which one was a continuation.

In total, therefore, 45 of the 78 projects or nearly 57 percent were continuations, and 33 were new.

During the year approximately 260 persons participated in the projects, as did 6 of the ARL staff. Seven of the principal investigators were not themselves at the ARL during the year. Two Japanese and two Swedish project personnel were included, as well as one Canadian project.

Complete reports are not available for November and December, but the monthly reports for the first ten months provided the following figures:

Projects and Investigators at the ARL by Month		
	Projects	Investigators
January	21	42
February	22	54
March	29	60
April	32	57
May	29	65
June	36	88
July	53	21
August	51	106
September	31	73
October	20	36

The total of 53 active projects for July was stated to be the highest total for any month in ARL history up to that time.

Drifting-station programs were more numerous in 1964, with six projects at T-3 and an equal number on ARLIS IL.

The T-3 based projects included:

1. Hunkins, acoustic and seismic study,
2. Akosofu, auroral study

3. Church, micrometeorology
4. Lachenbruch, heat-flow studies
5. Dunbar, physical and biological oceanographic studies
6. Buck, underwater acoustic research

The projects on ARLIS II were:

1. Mohr, marine biology
2. Wittmann, airborne remote sensing
3. Kusunoki, arctic oceanography
4. Wittmann, drift-station ice-strain studies
5. Ostenso, geophysical investigations
6. Church, micrometeorology studies

In addition to the twelve projects on T-3 and ARLIS II, there were also the two projects operating from ARLIS III during its occupation from February 10 to May 15. These were Dr. Hessler's magnetic investigations and Dr. Bennington's study of sea-ice physics. Beaumont Buck also was there for two days in April, and Den Hartog of the Ostenso gravity-survey party also used it.

In summary, 1964 was an extremely busy year at the ARL, with support being given to the greatest number of researchers for any one year up to that time. The expansion of programs in the physical sciences and the greater use being made of the drifting stations were notable features of 1964 ARL research. Most of the specific areas of investigation recommended by the 1963 Arctic Research Review Group were receiving some attention, although in some there was a mere beginning, and some other areas were not seriously touched upon. The balance between continuity and innovation in the research program remained much the

same, with slightly more than half of the projects being continuations or repeaters. Certain institutions remained heavily represented by ongoing programs, such as the University of Washington (Church and Bennington), the University of California (Pitelka), and the University of Wisconsin (Ostenso). Lamont, General Motors and USC also continued active programs.

THE RESEARCH PROGRAM IN 1965

The plans for the 1965 research program were based mainly on the continuation of the large scale, highly successful program of 1964. Most of the 1965 program involved a realigning and re-programming of research tasks and objectives for projects that already had established their worth, including the general direction of their field efforts. Thus, the several University of Washington projects (Church, Bennington, Kelley); the University of Wisconsin group led by Ostenso; the Lamont project (Hunkins); the Pitelka, Buck, Hessler, Mohr, Lachenbruch and several other projects were directed by experienced arctic investigators engaged in long-term research.

The Arctic Institute supported an ARL program, again with emphasis on the biological and social-archeological fields. Four of them were new projects (Coachman, Durham, Flyger, and Humphrey).

By continuing the project-counting method hitherto used by the ARL in its reports, there were a total of 86 projects in active operation at or out of ARL in 1965. Of them, 48 were essentially continuations of studies dating back to 1964 or earlier. In the ARL summary report submitted by letter to Mrs. Emilie Strand of ONR on November 5, 1965, some of the projects were listed as "visitor" projects. They included the Drobney, Luyet, Orth, Reid, Reiger, and Vibe projects. Another distinguishable group of listed projects was the group of seven INQUA projects. These

were all connected with the VII International Congress of the International Association for Quaternary Research, held at Boulder, Colorado, in August-September 1965. A preliminary field conference was staged in Alaska prior to the Boulder meetings, involving several geologists from non-American universities and institutions.

Again as in 1964 the physical-science projects were the most numerous, with 53, seven more than in 1964. Of them 29 were repeaters or continuations and 24 were new, including the 7 INQUA projects.

Projects concerned with gravity studies, magnetism, and acoustics again had the most numerous collection of investigations. Among the repeaters were Dr. Hessler with two projects on earth currents and on geomagnetic measurements; Dr. Ostenso with two projects, one gravimetric; Beaumont Buck with two underwater-acoustics projects, one on T-3 and one on ARLIS IV; Ken Hunkins' hydroacoustics project on T-3; Barnes' GS gravity survey of northern Alaska; Wescott's investigations of telluric currents; Richard Heidemann's world-wide gravity survey (a continuation of the previous Woollard project); Dr. Winckler's radiation measurements by polar-orbiting balloon; and finally, the C&GS operation of the Geomagnetic and Seismological Observatory under Patrick Clarke.

The new projects in 1965 included the following:

1. Arctic Weapons Acoustics, a GMDRL project under Beaumont Buck;
2. A Satellite Triangulation Station under LCDR Charles Burroughs, USN;

3. Geomagnetism Investigations, an AFCRL project under Jerry Cabanis;
4. Seismic Studies, under Andrew Gonda, Hudson Laboratory, Columbia University;
5. Alaska Seismic Work, under John Healy of the GS;
6. Radio Van Project by the Naval Communications Station, Kodiak;
- and
7. VLF Navigation, a project of WHOI under Jess Stanbrough.

The study of atmospherics, meteorology, micro-meteorology, and radiation continued nine projects, of which seven were repeaters. They included the two projects under Dr. Church at the ARL and on T-3; the atmospherics study under John Kelley; the aurora study under Afasofu on T-3; the Arctic Ionospheric Research project under Alton Crawley of the National Bureau of Standards; the Meteorological Sounding Rocket Program under Walter Galvin and Wendell Smith of NASA; and the Public Health Service project, Radiation Levels of the Atmosphere, under Jay Silhanek.

The new projects in 1965 were two: A Noctilucent Cloud Study by Benson Fogle of the University of Alaska; and a study of the Air Chemistry of the Halogens, under John Winchester of MIT.

Four of the ice and snow studies of 1964 were continued. They included Dr. Bennington's Sea Ice Crystallography study (part of a Church project); Walt Wittmann's Sea Ice Strain studies on ARLIS II; Guenther Frankenstein's Sea Ice Studies for CRREL; and Dr. Carl Benson's Reconnaissance Snow

Studies on the Arctic Slope of Alaska. The only new study was the Sea Ice Observations of the Kodiak Naval Communications Station.

Investigations under the oceanography label increased in 1965. The Kusunoki studies on ARLIS II were joined by a University of Washington project under Dr. Lawrence Coachman, conducting Oceanography Studies from T-3, and by the return to the ARL of Allan Beal, representing the Naval Electronics Laboratory, to investigate Arctic Oceanography.

The studies of soils, geography, and geology were pursued again by Jerry Brown (Frozen Ground Studies); Samuel Reiger's Collection of Soil Samples for the Department of Agriculture; Holowaychuk's Soil Studies of the Ogotoruk Creek Area for the AEC; Dr. Lachenbruch's Arctic Basin Heat Flow investigations on T-3 and ARLIS II; and the returning Irvin Tailleir of the GS to continue his geological studies, specifically labeled "oil shale investigations." New projects included another GS project under Donald Orth who was a "visitor" while working on his Geographic Dictionary of Alaska. Frank Preston, from Preston Laboratories, conducted Miscellaneous Ecological and Geological Studies, and Paul Sellman of CRREL made special Muskeg Studies.

The seven INQUA projects related primarily to permafrost, and included the following specific studies:

1. Permafrost Survey, by Jose Biggarella, University of Parana, Brazil;

2. Permafrost Features, by George Mitchell, Trinity University, Dublin, Ireland;
3. Permafrost Geomorphology, by Erwin Schenk, Geologische Forschungstell, Germany;
4. Study of Periglacial Geological Phenomena, by Jan Van Den Toorn, Netherlands Geological Survey;
5. Construction Cracks in Permafrost, by Peter Vogt (ARL reports do not indicate his actual arrival);
6. Paleobotany, Frozen Ground Features, by Richard West, University of Cambridge, England; and
7. Ice Wedge Polygons, by Rendell Williams, also from Cambridge.

Finally, included in this group of geographic-geological studies was one conducted by Robert Barsdate of the University of Alaska for the AEC, An Investigation of Local Lakes in Barrow Area, and another on Paleozoic Stratigraphy, by William Brosge, Geological Survey.

There were 22 projects in 1965 classified as wholly or partially biological. One of them, the Preston project, was also a geological project and has been included in the physical science group as well. Of the 22 projects, 15 were continuations or repeaters from the year before.

The returning or continuing investigations included:

1. Circadian Patterns in Arctic Microtines Exposed to Environmental Extremes, by Richard Andrews, Creighton University;

2. Marine Mammal Investigations - Walrus and Bearded Seal, by John Burns, Alaska Department of Fish and Game;
3. Seasonal Changes in Physiological Functions in Large Arctic Animals, By G. Edgar Folk of the Arctic Aeromedical Laboratory of the Air Force;
4. Flora of Alaska, by Eric Hulten, Naturhistoriska Riksmuseet, Stockholm;
5. Migrations of Ptarmigan: Absorption of Ultraviolet Radiation by Tissue of Eyes of Birds and Mammals, by Laurence Irving, University of Alaska;
6. Cytotaxonomic Study of the Flora of the Ogotoruk Creek Area, by Albert W. Johnson, AEC;
7. Evaluation of Vegetation Dynamics and Frost Action of Frost Boils, by Philip Johnson, CRREL;
- 8, 9, and 10. Arctic Basin Marine Biology, ARLIS II, T-3, and ARL, by John Mohr, USC;
11. Comparative Ecology of Lemmings and Other Microtines, by Frank Pitelka, University of California;
12. Ecology and Behavior of The Arctic Ground Squirrel, by William Reeder and Herb Melchoir, University of Wisconsin;
13. Productivity and Nutrient Cycles in the Soil-Vegetation-Animal Systems of the Arctic Tundra, by Arnold Schultz, University of California;

14. Stratigraphic Paleobotany in Northern Alaska, by C. J. Smiley, University of Idaho; and

15. Studies of Bi-polar Plants, by William C. Steere, New York Botanical Garden.

The new projects in the biological field were seven (including one aspect of the Preston investigations). They were:

1. Biology of the Bowhead Whale, by Floyd Durham, USC;
2. Phytoplankton Studies - Arctic Basin, by Coachman, University of Washington;
3. Population and Movement Pattern of the Polar Bear, by Vagn Flyger, University of Maryland;
4. Restoration of Sap Movement in Arctic Shrubs During the Time when Freezing and Melting are Frequent, by Laurence Irving, University of Alaska;
5. Classification and Ecology of Microorganisms and Fungi, by Yosio Kobayasi, National Science Museum, Japan;
6. Plant Communities of the Tundra, by Augustus Kuchler, NSF; and
7. Miscellaneous Ecological and Geological Points, by Frank Preston, Preston Laboratories.

Social-science projects received greater attention in the 1965 program than in previous years. A total of ten projects were in this group, including four repeaters and six new projects.

The four repeaters included:

1. An Archeological and Ethnological Reconnaissance of the Middle and Lower Noatak River, Northern Alaska, by Edwin S. Hall, Jr., Yale University;
2. Investigations of Radioisotopes in Alaska Eskimos, by Wayne Hanson, Battelle Memorial Institute, Northwest Laboratories;
3. Physiology of Arctic Survival, by Frederick Milan, Arctic Aeromedical Laboratory; and
4. Zoonotic Disease Studies, by Robert Rausch, Arctic Health Research Center.

The new social-science projects included:

1. Archeological Study of the Middle and Upper Utukok River, Alaska, by Robert Humphrey, University of New Mexico;
2. Tissue Freezing and Thawing, by Basile Luyet American Foundation of Biological Research;
3. Fallout Ratio and Mechanisms of Airborne Radionuclides, by R. W. Perkins and George Rieck, Battelle Memorial Institute,
4. Sanitation and Land Fill Studies, by Leroy Reid, PHS;
5. Oral Pathology in Arctic Amerinds: An Interdisciplinary Study, by Nathaniel Rowe, Washington University of St. Louis; and
6. Whaling Practices of the Barrow Eskimo, by Christian Vibe, University of Copenhagen, Denmark.

Other projects included a Survey of Arctic Construction Techniques, by LT Neil Drobney of NCEL; and operation of a Mobile Photographic Unit

(ARLIS II), by C. Stancil.

Aside from the seven INQUA projects, the 1965 program was approximately of the same dimensions as the 1964 program. The proportion of repeaters or continuation projects was also similar. In the physical sciences, the proportion was a bit higher if the INQUA projects are not considered.

Personnel rosters for the year are not available, so the total number of investigators could not be determined or compared.

If the Preston project is considered to have been a physical-science study, the distribution of the 1965 projects among the sciences was as follows:

<u>Science</u>	<u>New Projects</u>	<u>Repeaters</u>	<u>Totals</u>
Physical	24	29	53
Biological	6	15	21
Social	6	4	10
Other	<u>2</u> 38	<u>0</u> 48	<u>2</u> 86

Of the 26 educational institutions represented in 1965, 8 were foreign, including institutions in Japan, Brazil, Ireland, England, Germany, and Denmark. United States universities were led by the previous leaders, the universities of Washington, Alaska, Wisconsin, California, and Southern California.

Government agencies again were represented heavily with twenty agencies involved. The Geological Survey was most involved, having a total of six projects. CRREL was second, with four projects.

Ice-island based research was continued with considerable emphasis. A total of 15 projects were at one time or another based on T-3, ARLIS II, or ARLIS IV.

Eight projects, including five which were continued from the year before, were on T-3. Dr. Dunbar did not return, but three new projects moved in. They were the Coachman, Mohr, and Ostenso projects.

The greater concentration of research on T-3 was a consequence of what was happening to ARLIS II. The research parties that had operated from ARLIS II during 1965 included representatives of the Kusunoki, Lachenbruch, Mohr, Ostenso, and Wittmann parties. After the abandonment of ARLIS II, research was concentrated on T-3 and on such auxiliary and temporary stations as were needed. In 1965 this was done on ARLIS IV, with Dr. Hessler and Beaumont Buck as the principal users.

In summary, 1965 was another year of expanding research with the major emphasis again on the physical sciences. Ten projects classifiable as social-science projects was an increase and the highest total to that date. Biological sciences suffered a slight reduction, but the emphasis again was on the continuing well-established projects of leaders such as Frank Pitelka and John Mohr.

OPERATIONS AND ADMINISTRATIONS IN 1966

Although 1966 was a nearly normal year at the ARL because routine had been well established, nevertheless some modifications were made when they were needed to improve operations. In January, 57 ARL personnel were listed. In June, reflecting the active season, the number was up to 74; and in December the number had dropped again to 60. The numbers by categories were:

<u>Personnel</u>	<u>January</u>	<u>June</u>	<u>December</u>
Administrative	12	13	13
Flying	6	7	6
Service	10	18	10
Shop	17	22	14
<u>Equipment</u>	<u>12</u>	<u>14</u>	<u>17</u>
Total	57	74	60

None of the figures above include personnel on Ice Island T-3 or other major field camps. Some of the positions were occupied only part time.

A general picture of the work load is given by the number of projects supported and their range throughout the year, as indicated below:

<u>Projects Supported</u>			
January	19	July	45
February	19	August	51
March	29	September	36
April	28	October	25
May	35	November	24
June	41	December	21

Distinguished visitors stayed for a few hours to a few days at the ARL during the year. Always they were welcomed, not only because the ARL personnel enjoyed having guests, but also for the advice that most gave based on their wide and varied experience and because receiving visitors was a good way to spread an appreciation of the ARL and its work throughout the United States and the world. A rough count shows that more than 200 visitors were at the ARL in 1966 and they came throughout the year - not just in the summer. A few are listed below as samples of the diversity of the visitor pattern.

In February: Dr. Max Adenauer, recently Mayor of Cologne, Germany

Dr. Ian Hampton, Medical Research Council of Great Britain

Dr. George Kimble, 20th Century Fund, New York

In March: MAJGEN James C. Jensen, Commander, Alaska Air Command

MAJGEN Gary C. Carver, Commander, U. S. Army, Alaska

MAJGEN A. J. Beck, SAC

In April: BRIGGEN F. C. Gray

Senator E. L. Bartlett, Alaska

Congressman Ralph Rivers, Alaska

In July: MAJGEN Victor R. Hangen, Commandant, A. F. Institute of Technology

MAJGEN R. H. Curtin, Director of Civil Engineering, USAF

MAJGEN B. C. Harrison, Director, Manpower and Organization, USAF

Dr. Wm. R. Wood, President, University of Alaska

Dr. M. E. Britton, Head, Arctic Program, ONR

Mr. Hiroyuki Nishida, Library of Universal Folkways, Tokyo

Mr. Richard Heidemann, Hawaii Institute of Geophysics,
Honolulu

In October: RADM F. B. C. Martin, USN (Ret.) and Manager of the
DEW Line

RADM Paul A. Smith, C&GS (Ret.) and the Rand Corporation

In December: Mr. Susumu Noro, Nippon Television Network Corporation,
Tokyo

LTGEN Glen R. Birchard, Commander, Alaska

Even the weather in 1966 appeared to be nearly normal. For that
reason the following table is included and shows some of the weather data
by months with a note where appropriate.

Weather at the ARL in 1966

Month	Avg. Temp. in degrees F.	Min. Temp. in degrees F.	Max. Temp. in degrees F.	Avg. Wind in mph	Precip- itation in inches	Notes
Jan.	-15.7	-40	16	12.0	0.12	Near normal
Feb.	-22.4	-42	6	7.7	0.06	Colder than normal
Mar.	-22.9	-48	13	9.6	0.20	Cold
Apr.	- 5.1	-25	22	11.6	0.28	Cold
May	16.1	- 3	35	8.8	0.15	Cold
June	35.1	22	58	10.7	0.37	Normal
July	37.4	28	59	11.0	2.01	Rainy
Aug.	34.9	27	49	14.4	0.57	Cold & Dry
Sept.	31.0	24	42	13.4	0.48	Normal
Oct.	18.5	-15	32	14.1	0.49	Near normal
Nov.	6.4	-15	28	18.4	0.51	Warm & Windy
Dec.	-12.2	-35	25	9.3	0.23	Normal

As the year opened the ARL had a stable of 4 Cessna aircraft and 1 R4D (no. 776). January flying was characterized by nine R4D flights to T-3 mostly to augment the low fuel supply there. There also were a number of flights in search of a lost local pilot. February had fewer flights than usual but there were seven in the R4D to T-3. Cessna flying included nine flights for a total of 25 hours. Much more flying went on in March — a total of 302 hours in 91 flights — 21 hours and 7 flights being in a rented Super Cub. The flying was much less in April for two reasons: - The R4D had some minor repair, but more importantly, had to go through a routine 100-hour inspection; 2 - The monthly report points out that "On the morning of the 24th a recently appointed fire watchman entered the locked aircraft hangar during his appointed rounds, decided that he had never been in light aircraft, entered Cessna N2145Z, which was on ski-wheels, and started the engine. The aircraft moved forward, running into Cessnas N2654Y and N2722X, extensively damaging three wings and the propellers of all three aircraft. With three of the four ARL Cessnas temporarily out of operation the over-ice flying program was immobilized for the rest of the month."

In May 1966 the ARL aircraft situation improved greatly. A total of 280 flying hours were logged. Cessna N2722X was returned to service on May 2 and N2654Y on May 19. In addition, the second R4D (No. 217) that had been sitting on T-3 after its "nose-up" in March 1965 was repaired on

the station and returned to the ARL on the 30th. The last of the Cessnas involved in the har incident in April (N2145Z) was returned to service on June 5. That month a total of 323 flying hours were logged.

Flying hours totalling 406 in July set an ARL record. The Cessnas flew 327 hours in 93 flights and R4D 776 flew 79 hours in 13 flights. In addition the Alaska Air National Guard made six C-123 flights to T-3 to deliver diesel fuel. The airstrip was unusable because of an early summer melt and therefore a low-level, free-fall technique was used. The lagoon near the ARL that was used for float planes became ice free on July 9 and an ARL aircraft on floats began using it that afternoon.

By September flying was down to less than half that of July. Twelve flights by R4D 776 in September included six ice-reconnaissance flights between Barrow and T-3 in support of the USS BURTON ISLAND. October was characterized by very little flying - only 96 hours. The R4D was down for most of the month for major inspections plus an engine change. Therefore the assistance of a Navy R5D from Kodiak was most welcome. That aircraft made fifteen flights to T-3 with fuel and, in addition, handled routine personnel transfers to and from the ice island.

During the whole year the ARL flight time was 2612 hours, 1808 hours with light aircraft and 804 hours with R4D 776. For comparison, a total of 176 hours was logged 10 years before in 1956.

During January, a typical winter month for maintenance, the ARL staff provided technician assistance and routine services to the various projects. Other chores included:

1. Completing the replacing of the NASA launch-pad roof with heavier timbers (699 man hours);
 2. Routine support for meteorological sounding-rocket series (344 man hours);
 3. Continued construction of a wolf cage (636 man hours);
 4. Overhaul of generator and heaters returned from ARLIS II (230 man hours);
 5. Continued rehabilitation of quarters building (549 man hours);
 6. Remodeling quarters building 264 (362 man hours);
 7. Repairing and painting interior of dormitory building 251 (296 man hours);
 8. Start of construction of two new man-haul cabs (215 man hours);
- and
9. Completing a battery wanigan for the aircraft hangar (116 man hours).

Of special note in March was the greatly increased maintenance work in connection with beginning the complete rehabilitation of the T-3 station, the establishment of a satellite camp to T-3, and the building of wanigans for the expansion of the Meade River Camp. During April the rehabilitation of T-3 and the construction of wanigans for Meade River went on unabated.

Also during April the DARL, the Assistant DARL, Chief Pilot Robert Fischer, and Carl B. Johnston, Jr. all attended a symposium at Airlie House, Warrenton, Virginia, on Arctic Drifting Stations. The symposium was managed by the Arctic Institute of North America for the Office of Naval Research.

The following month, May, rehabilitation of the T-3 camp continued, the camp was moved, and the T-3 satellite camp was evacuated. Also the Meade River camp was established as a long-term, year-around facility. The camp, 70 miles southwest of the ARL, consists of four 14 x 20-foot wanigans (one sleeping, one mess hall/galley, and two scientific), and two 8 x 8-foot generator wanigans. The whole camp was transported from the ARL by two D-8 tractors — each pulling four sleds. The snow was unusually deep and the lead tractor had to plow the entire distance. The round trip took nine 14-hour days. During the month the live animal collection was increased by two polar bear cubs and five wolf pups. Dr. Britton from the ONR visited the ARL in mid-month. He and the DARL then went to Seattle to confer with shipyard representatives on extensive modification underway of the boat NATCHIK.

By July, at the height of the season, field stations were operated for all or part of the month at T-3, Meade River, Cape Thompson, Cape Beaufort, Wainwright, Umiat, and Anaktuvuk Pass. Tent parties were established on the Kukpowruk, Ikpiuk, and Colville rivers. A start was made on refurbishing the old ARL boat IVIK, including the installation

of a new engine; and the NATCHIK went back into operation.

August was a routine month from a maintenance and operations standpoint, except for survey or review visits from a number of groups and individuals that collectively took a large amount of staff time. These were in addition to the arrival and departure of several distinguished official visitors. The review visits included:

1. A group of officials of the Bureau of Indian Affairs to discuss a proposed new gas line to the village of Barrow as well as the anticipated requirements of the needs of the village for the next few years for both gas and electric power;
2. Dr. Bernard Roxx to discuss the possibility of initiating an ice-penetration study;
3. Three officials from the AF Cambridge Research Laboratory to discuss a program of upper-atmosphere research;
4. A party from the National Geographic Society to film various aspects of arctic research;
5. An official of the Naval Facilities Engineering Command, Seattle, to survey the AHL and camp electrical systems and possible extensions for future requirements;
6. Peter Bock, Illinois Institute of Technology, to discuss a possible future sea-ice project of NAVOCEANO; and
7. An official of the Defense Documentation Center to explain the functions of that Center and how it might help the ARL.

Maintenance during September was devoted largely to cleaning up the summer's operations and preparing for the winter projects. It will be remembered that the long spit projecting northward from the camp area was breached in several places by the storm of October 1963. Since then the openings had gradually been filling in. The last remaining break was filled with old weasel bodies in October 1966 and then covered with gravel. Once again it was possible to drive to Point Barrow.

December was a routine month. In addition to providing the normal support services to projects, the staff:

1. Continued repair of quarters building (118 man hours) and painting of the laboratories (407 man hours);
2. Continued construction of weasel cabs and a D-8 cab (400 man hours);
3. Continued rehabilitation of the office area (442 man hours);
4. Continued construction of a polar-bear house (786 man hours);
5. Continued rehabilitation of the animal complex (410 man hours);
6. Provided support for the Meteorological Rocket Sounding Program (439 man hours);
7. Provided field support for a Sea Ice Crystallography Project (155 man hours); and
8. Started installation of a new heating system in the mechanical shop (74 man hours).

During December a polar bear went to sleep in the roadway along the beach between the village and the ARL. He was disturbed by the manhaul bringing the men to work and departed unharmed. The DARL attended a meeting in San Diego of representatives of ONR, NEL, NAVOCEANO, and scientists having or planning research programs on T-3. He also visited the Northwest Division of the Navy Facilities Engineering Command to review plans for the new ARL laboratory building.

The field station on Fletcher's Ice Island, T-3, was operated throughout 1966. The activity there ranged widely as indicated in the following table that shows, according to the record in the monthly reports, the number of investigators and the number of ARL staff in each month. In a good many instances some of the people, especially the ARL staff people, were on the station for only a part of the month, perhaps a day or two only, for some special purpose. Thus the figures do not indicate that each individual recorded was there for the full month.

<u>Personnel on T-3 in 1966</u>		
<u>Month</u>	<u>Investigators</u>	<u>ARL Staff</u>
January	11	4
February	7	5
March	20	12
April	22	13
May	28	26
June	23	23
July	18	7
August	19*	7
September	22	8
October	19	5
November	17	5
December	14	4

*The record shows an increase of one from July to August during an interval when there were no landings on the station. It is believed that the record is in error by one either for July or for August.

Fuel was short on the station in January because of the inability to deliver the fuel supply in the fall of 1965. Air support consisted mostly of fuel haul. During the month the camp was fully inspected and the inventory brought up to date. This resulted in recommendations for some changes in camp operation, including an urgent recommendation for additional recreational facilities. An estimate was made for the rewiring of the whole camp. The sun returned to T-3 on February 9 and morale picked up. The site for a satellite station was selected about four miles from T-3 on sea ice. Air service to the ice island was good in March. There were 26 aircraft arrivals. The satellite station was established between March 10 and March 13, when it became operational. All materials, including the four wanigans, were hauled from T-3 by weasel and assembled on the spot.

T-3 was plagued in April with two major fires and two buildings, technical equipment, and records were lost. As a result some more rigid housekeeping rules were drawn up and strictly enforced. Drilling on T-3 indicated the island ice to be 102 feet thick in the camp area. May was a busy month. Forty-four aircraft flights arrived with the attendant labor of unloading and storing. Most of the camp was rewired. The trailers and wanigans were moved off their 6-foot ice pedestals. The downed aircraft, R4D 217, was dug out of the snow and two new engines and propellers installed. The plane was operational and flew off to Barrow. The satellite station was evacuated by the Cessnas because

a lead between the station and T-3 prevented evacuation over the ice. The airfield closed for the summer on June 15.

Work progressed on a routine basis during the summer. Of great interest during September was keeping track of the icebreaker BURTON ISLAND as she tried to reach the island to resupply it, mostly with fuel. The ship departed Barrow on September 2 and encountered heavy ice at $73^{\circ}-14'N$, $155^{\circ}-44'W$. On September 11, when at $74^{\circ}-10'N$, $157^{\circ}-37'W$, the battle was lost and the ship had to turn back. The airstrip was reopened on the 20th and received the first aircraft of the new season on the 22nd. In the following months a big item was resupply of the station with fuel by air.

THE RESEARCH PROGRAM IN 1966

Addendum No. 1 to the December 1966 ARL Progress Report listed 79 research projects or "tasks underway at the ARL during calendar year 1966," together with the names of the principal investigators and the institutions, agencies, or firms they represented.

Addendum No. 2 to the same report listed the names and institutions or agencies of "the investigators and assistants working at or out of ARL during calendar year 1966." The list totals 299. However, 22 of them were starred as not present at the ARL during the year. Of the assistants listed 11 were ARL personnel. There were therefore 277 investigators and assistants, of whom 266 came from outside the ARL.

Of the 79 projects operating in 1966, 44 were repeaters or continuing researches. This followed the pattern of having at least half of the program continued from the year before. To a greater extent than before, however, the principal investigators for the continuing projects left the field research to assistants and were not themselves in attendance at the ARL. The 22 investigators listed as "not present at ARL" were all principal or co-leaders of projects. Among them were such familiar ARL researchers as Hunkins, Lachenbruch, Mohr, Ostenso, Rausch, Sellery, Silhanek, Steere, and Untersteiner.

The month by month numbers of active projects and investigators were as follows:

<u>Month</u>	<u>Number of Projects</u>	<u>Number of Investigators</u>
January	19	37
February	19	34
March	29	53
April	28	59
May	35	77
June	41	104
July	45	106
August	51	130
September	36	66
October	25	49
November	24	38
December	21	36

The 1966 program included projects from 25 universities or institutes, including three Canadian. Of the 25 institutions represented, 5 had more than one project. The University of Alaska led with 12; the University of Washington had 9; and McGill, USC, and SRI had 2 each. As usual, government agencies were second in representation, accounting for 27 projects as compared with the 47 from universities. The 27 projects were sponsored by 17 agencies. The GS had six projects; CRREL had three; and the AEC, Arctic Aeromedical Laboratory, and the Alaska Department of Fish and Game had two each.

In addition to the 74 projects accounted for above, there were also project leaders from such institutions as the Bernice P. Bishop Museum, the New York Botanical Garden, Ferguson Kerr, Ltd., Japan Broadcasting Company, and the General Motors Defense Research Laboratories.

After ARLIS II was evacuated off the Greenland Coast in May 1965,

the ice-island research program was concentrated on Fletcher's Ice Island, T-3. For a period in the spring of 1966 a floe three miles from T-3 was occupied. That station, familiarly called T-3 1/2, was evacuated on May 21.

Thirteen projects were operative at some time or other on T-3 during the year. They included projects led by Lachenbruch, Hunkins, Coachman, Dunbar, Buck (2), Church (2), Akosofu, Lewis, Mohr, English, and Rockney.

By field of research the 1966 projects were divided as follows:

Physical sciences	38
Biological sciences	32
Social sciences	6
Other	3
	—
Total	79

These figures show a marked change from 1965 which had 53 projects in the physical sciences and only 22 in the biological field.

The drop in numbers of research projects in the physical sciences reflected mainly a reduction in the number of new projects. Of the 38, only 12 were new as compared with 24 new projects the year before. The 1965 INQUA "projects" did overemphasize both the number of new projects and the number of physical-science projects that year.

Research in gravity, geomagnetism, acoustics, and seismics in

1966 consisted of nine projects, none of which were new. The 1966 studies included the David Barnes gravity survey for the GS; two Beaumont Buck underwater acoustics projects, one on T-3 and the other on the T-3 satellite; two of Victor Hessler led projects, one the earth-current study, the other a geomagnetic measurement study for the Air Force Cambridge Research Laboratories; the continuing hydroacoustical project on T-3 under Kenneth Hunkins; the operation of the Geomagnetic and Seismological Observatory by John Townshend for the C&GS; the gravity investigation in the Arctic Ocean basin by Ned Ostenso; and, finally, the investigation of telluric currents by Eugene Wescott of the Geophysical Institute.

Atmospheric, meteorologic, and radiation research was also in the main a continuation of on-going projects. There were nine of them; the NBS ionospheric research under Dr. Sellar; the atmospheric chemistry project on T-3 led by Drs. Church and Untersteiner; the Akosofu aurora study at Barrow; the two Church investigations of arctic air, sea, and ice environments at Barrow and on T-3; the meteorological sounding-rocket program by NASA; the PHS recording of radiation levels (Dr. Silhanek); and the Radio Van Project by the Naval Communication Station at Kodiak.

The two new projects in 1966 were Dr. Akasofu's aurora study on T-3 and the Weather Program on T-3 under the direction of Vaughn D. Rockney, Chief of the Operations Division of the Weather Bureau.

Ice and snow studies in 1966 were continued in two projects, one the

reconnaissance snow studies of Carl Benson; the other the sea-ice physics study under Church and Untersteiner. Two new projects were on the scene, one a study in penetration of arctic sea ice by Dr. Bernard Ross from the Stanford Research Institute; the other a sea-ice reconnaissance survey, a Navy project carried out by Fleet Weather Central from Kodiak.

Oceanographic research consisted of three projects so labeled; the continuing Arctic Oceanography project on T-3 under Dr. Coachman; another Coachman-led study of Bering Sea Currents; and GS Delineation of Submerged Drainage Channels and Beach Lines under David M. Hopkins.

Geology, geography, and soils research comprised eleven projects, of which five were continuations. They included the Arctic Basin Heat Flow project on T-3, under Dr. Lachenbruch; the Barsdate investigations of local lakes in the Barrow area; the frozen-ground studies by Dr. Jerry Brown; the Muskeg Studies under Paul Sellman from CRREL; and the oil-shale investigations by George Gryc for the GS.

The six new studies included an Engineering Geology Reconnaissance of Alaska Coastal Communities, a GS project under Richard W. Lemke; an investigation of coal deposits in the Kukpowruk River area by Alexander Wanek, also for the GS; an Investigation of Cretaceous Rocks on the Kuk Inlet, by Dr. Charles E. Helsley from the Graduate Research Center of the Southwest; an investigation of the Morphology of Arctic Coasts and Deltas by Dr. Harley J. Walker from Louisiana State University; new

permafrost studies by Harold Peyton for the Arctic Environmental Engineering Laboratory at the University of Alaska; and, finally, the Thermal Erosion Studies in Fluvial, Lagoon, and Ocean Environments by Robert I. Lewellen of the University of Denver.

As has been noted, the research program in biological fields was considerably enlarged in 1966. A total of 32 projects were pursued, of which 13 were repeaters or continuations and 19 were new. Of the 32 studies, 8 concerned the flora, 20 the fauna of the region, and 4 were concerned with both.

Studies of plant life included four repeat projects, namely the Evaluation of Vegetation Dynamics and Frost Action of Frost Boils, the CRREL study under Philip Johnson; Stratigraphic Paleobotany in Northern Alaska, Charles Smiley's project; William Steere's Study of Arctic Mosses; and William Boyd's study of Thermophilic Bacteria in Arctic and Sub-Arctic Habitats. The four new projects included an investigation by Dr. George W. Argus, from the University of Saskatchewan, into the Biosystematics of Arctic Willows; a project by Dr. Larry L. Tiezen, from the University of Minnesota, called Determination of Pigment Content and Other Leaf Characteristics of Arctic Grasses; a study of Environmental Influences on Infection by Fungus Plant Parasites by Dr. Eugene L. Sharp, from Montana State University; and Marine Plankton Studies by Miss Rita A. Horner of the Department of Botany at the University of Washington.

Projects concerning arctic fauna included six continuations and 14 new projects. The six included Durham's study on the Biology of the Bowhead Whale; Andrew's study of the Comparative Ecology of Mammals and Birds in Arctic Tundra Ecosystems (a change in title); the study of Ptarmigan Migration by Irving and Scholander; Flyger's research into the Population and Movement Pattern of the Polar Bear; and Edgar Folk's study of Seasonal Changes in Physiological Functions in Large Arctic Animals.

New projects concerning arctic fauna included a study of the Biology, Behavior, and Orientation of Bees in the Arctic by Dr. William P. Stephen from Oregon State University; Dr. Norman J. Wilimovsky, from the University of British Columbia, doing an Evaluation of Under Ice Sampling Device; a Goose Production Survey of the Arctic Slope by James King of the Fish and Wildlife Service; Lipid Studies on T-3 and at Barrow by Dr. Roger W. Lewis from the Institute of Arctic Biology at the University of Alaska; a project concerning Physiological Studies of Arctic Mammals by COL Evan R. Goltra from the Arctic Aeromedical Laboratory at Fort Wainwright; a Pleistocene Fossil Collection (Ikpikpuk River) by Dr. Russell D. Guthrie from the University of Alaska; and a part of a study of Poisonous and Venomous Marine Animals of the World, by Dr. Bruce W. Halstead from World Life Research Institute for the Bureau of Medicine and Surgery, USN.

Also new in 1966 was a Polar Bear Survey by Jack W. Lentfer of the Alaska Department of Fish and Game; an SRI project by Dr. Thomas C. Poulter in Recording of an Underwater Signal of Arctic Seals and Sea Lions; another Alaska Department of Fish and Game project led by Dr. Kenneth A. Neiland, called Studies of Diseases of Arctic Caribou; a Study of Natural Airborne Dispersal of Insects and Other Animals, by Dr. Carl M. Yoshimoto of the Department of Entomology, Bernice P. Bishop Museum, Honolulu; a study of Systematics and Ecology of Arctic Sponges by Dr. Frank J. Little of the Institute of Marine Sciences, University of Alaska; a project on Thermoregulation and Bioenergetics of the Snowy Owl by James A. Gessaman from the University of Illinois; and, finally, a study of the Water Balance in the Wolverine, by Dr. Robert E. Henshaw from the Carnegie Institute of Technology.

Four other biological-science projects were not so clearly concerned with the distinction plant or animal. One of them was the continued study of Arctic Plankton Ecology by Dr. M. J. Dunbar at T-3; another was the Marine Biology Study, also continued on T-3 by Dr. Mohr; and also the T-3 study of Marine Ecology and Productivity by Dr. Thomas English. A new project in 1966 was the investigation of the Ecology of Some Arctic Hot Springs by Dr. Jacob Kalff and Dr. John E. Hobbie, both from North Carolina State University.

There were six projects in the social-science area during 1966.

Only one of them was a new project.

The repeaters in 1966 included the following:

1. Dr. Robert L. Humphrey, Archeological Study of the Middle and Upper Utukok River;
2. Richard W. Perkins and George Rieck, Fall-out Rates and Mechanisms of Airborne Radionuclides;
3. Wayne C. Hanson, Investigations of Radioisotopes in Alaskan Eskimos;
4. Dr. Frederick A. Milan, Physiology of Arctic Survival; and
5. Dr. Robert L. Rausch, Zoonotic Disease Studies.

The new social science project was that of Dr. William M. Smith from Walter Reed Institute of Research of the Walter Reed Army Medical Center in Washington, D. C. His project involved Measurements of Informal Structure and Effects of Temporary Residents in a Small Arctic Community. Dr. Smith had done a previous study in the Antarctic involving a small isolated group observed during a four-month trek across the polar plateau.

Not classifiable in one of the three major discipline categories were three activities listed as projects. These included a documentary filming operation for the Japan Broadcasting Company in Tokyo by Yoshiro Yanagawa and Yoshio Kato on behalf of Koyo Tsuchiya, project director. They obtained 8,000 ft. of film to be used in making two 30-minute color programs for television.

On March 8 a three-man film team, led by Graeme Ferguson, arrived to make sequences for a film entitled Man and the Polar Regions, in 35 mm color. The film was to be shown at EXPO 67 at Montreal.

Finally, another activity listed as a project, was the attempt by the USS BURTON ISLAND to reach T-3 on a resupply mission during early September. Ice conditions forced the ship to turn back and unload its cargo at Barrow.

THE STORY FROM THE PEOPLE WHO WERE THERE

The history of the Arctic Research Laboratory is far more than an account of administrative actions and of research projects undertaken at or out of the Point Barrow installation. Much of that history is discoverable in the records and lives in the recollections of the hundreds of investigators, technicians, and administrators who were present at the Laboratory for longer or shorter periods. How was this important source of information to be tapped?

It was realized that personal interviews, while highly desirable as a method of gaining facts and impressions, were not a practicable means of reaching a significant percentage of the individuals whose story would be of interest. Nevertheless, the personal-interview procedure was followed to the extent feasible. About 40 persons were interviewed. Some of them were selected by deliberate choice; others were determined by discovered accessibility. For obvious reasons the persons interviewed included a disproportionate number of administrators and senior or principal investigators. Beyond that, however, was a random sampling of researchers of different ages, representing several fields of investigation.

In order to reach as many as possible of the hundreds of widely scattered individuals, it was decided to use the questionnaire method. It was realized that that procedure would have serious drawbacks and

would not get complete coverage. The assumption was made that because it would be unrealistic to expect complete statistical information through the use of the questionnaire, the sights would be set somewhat lower — to get a reasonably good cross-section sampling. We believe that this was achieved, but there is no demonstrable proof of that.

Procedurally, the first step was to assemble names and addresses of those to be questioned. Incompleteness of some early records made even the name collecting more than a simple chore. For the latest ten years, beginning in 1956, the names could be taken mainly from the ARL Monthly Progress Reports. Altogether some 1088 names were collected. Finding current addresses became a far more difficult problem. By a combination of several sources, including the help of the ARL itself, addresses of reasonably recent vintage were tabulated for 729 of the 1088.

The questionnaire therefore was sent to those 729. Despite the care that had been taken, 84 of the mailed questionnaires were returned as undeliverable. That left 645 presumably delivered questionnaires. Of them, 12 addressees later were reported deceased. Presumably, therefore, the questionnaires reached about 633 persons. By the arbitrary deadline, 322 questionnaires had been returned in more or less completed form. For a variety of reasons many of them were only partly completed, hence there were not 322 responses to every question. That had been

anticipated. Nevertheless, some response was received from approximately 30 percent of the names that had been listed, and about 50 percent of those that presumably had been reached. A few came in later but were not used in the statistical analysis.

The Questionnaire

The formulation of a "good questionnaire" may be, almost by definition, an impossible task. With the benefit of hindsight it is clear that a much better one could have been assembled. Nevertheless a good deal of meaningful statistical information was gathered, and, perhaps more important, a considerable collection was made of personal observations, reactions, and assessments. In total, the exercise proved to be revealing and useful. Figure 3 is a copy of the questionnaire.

One purpose of the questions was to gather essentially statistical information. For example, it was thought desirable to assemble information, to add to the information in the official records, from researchers on the year, the time of year, duration of the stay, number of returns to the ARL, and other facts relating to their time at the ARL. Statistical distribution among the fields of investigation was another concern that required further information from the investigators.

The question of sponsorship of the research was raised in question 3, together with related questions about arrangements, costs, etc. For a

Figure 3 (sheet 1 of 3)

QUESTIONNAIRE

**FOR RESEARCHERS AT THE ARCTIC RESEARCH LABORATORY,
FOINT BARROW**

1. When (preferably between what dates) were you at, or working out of, the Arctic Research Laboratory?

For what purpose were you at the ARL?

2. What was your primary field of interest?
3. Was your work supported by an agency or organization other than the Office of Naval Research?

IF SO:

What arrangements were worked out with ARL by you? by the agency or organization?

Were you an employee of that agency or did you work under a contractual arrangement?

What would you estimate was the cost of the program to the agency or organization supporting it?

Would there have been alternative ways of accomplishing the work if the ARL had not been in existence?

If so, what do you estimate it would have cost?

4. How did your work at the Arctic Research Laboratory advance you in your scientific progress?
5. Did it influence a substantial part of your career to be in the Arctic or Subarctic? Exemplify.
6. Did it kindle a long-term or permanent interest in arctic research?

Figure 3 (sheet 2 of 3)

7. Did your work at ARL contribute to your particular discipline
in lower latitudes? Moderately? In a major way?
Not at all?
8. List publications resulting in whole or in part from your work
at Barrow. (If you have a prepared bibliography, please attach
a copy.)
9. Were other persons, especially young researchers, participating
in your project?
 IF SO:
 What were their names?
- Did they get an advanced degree based in part on the work
 done on the project? What degree?
- Did they write a thesis on it?
 If so, its title?
- Published? Institution?
10. Did any of them become interested in arctic research and carry
on later work there? How many did?
 How many did not? Why not?
11. What, in your opinion, has been the impact of the ARL?
 On the Navy?
- On other agencies of government?

Figure 3 (sheet 3 of 3)

On the universities?

On national defense?

On science?

Nationally?

Internationally?

What have been its strengths?

Its weaknesses?

12. Could you provide us with any illustrative material, such as black and white glossy photographs of historical value which depict aspects of your field of research, for example, pictures of personalities, significant before-and-after pictures of the Laboratory, etc. ?

Name _____ Date _____

number of reasons the question in many cases did not yield all the information desired. Questions 4, 5, 6, and 7 were designed to probe the effects on the interests and careers of those who had been at the ARL. Those questions did produce meaningful answers from many. Question 8 on publications was taken seriously by nearly all respondents and proved to be a useful question, despite some unavoidably fuzzy aspects of any statistical summary of the answers.

Questions 9 and 10 were designed to expand the range of information on the subjects of advanced degrees earned, theses written, and interest in arctic research stimulated by work at the ARL. The third-person approach used proved to be less productive than hoped for. It is clear that direct questions about the individual himself, rather than his colleagues, would have produced more useful information.

Question 11 on the individual's estimate of the impact of the ARL was left blank by many, and others responded only in part. Nevertheless, it proved to be a stimulating question to many, and the responses will be analyzed in detail. They threw considerable light on the several areas of possible impact and in many cases contained frank statements of personal reaction to the ARL operation and administration. The covering letter sent with the questionnaire had asked for frank replies, and it seems reasonable to conclude that this injunction was taken seriously. The tone of replies to question 11 appeared to bear this out.

When and Why Were Researchers There

The story of the ARL is partly illustrated and revealed by looking into statistical materials on the researcher population working out of the Laboratory in terms of when they were there, how long they stayed, how many were repeaters, and how many did not return. The statistical information provided by the answers to the questionnaire is, of course, fragmentary; therefore a degree of caution is prudent in any attempt to evaluate the results. The sampling, however, is rather large — estimated at about 30 percent of researchers and others who had been at the ARL — and there are no clearly discernible reasons to suspect that the sampling is heavily weighted in any particular direction, unless one wishes to assume that those who took the trouble to return the questionnaire thereby revealed an idiosyncrasy which in part provided a distorted picture. If the latter is true, one might expect the degree of distortion to be greatest on the replies to questions which called for subjective impressions or judgments and smallest on the purely factual responses.

Approximately 314 who answered the questionnaire gave usable information on when and for what periods they had been at the ARL or had worked out of there. The distribution of researchers by season as reported on the questionnaire showed a general pattern, as expected, of heavy concentration during June, July, and August for the first

dozen years of the ARL (see tabulation below).

ARL Research Concentration in Summer Months

Year	Man- Months June- Aug.	Man- Months Other 9 Months	Percent in Summer	Percent in Other Months
1947	2	4	33	67
1948	21	5	81	19
1949	23	0	100	0
1950	16	14	53	47
1951	41	8	84	16
1952	47	11	81	19
1953	50	22	70	30
1954	33	27	55	45
1955	42	26	62	38
1956	46	15	75	25
First 10 Years	321	132	71	29
1957	55	17	76	24
1958	78	46	63	37
1959	61	57	52	48
1960	85	90	48	52
1961	120	83	59	41
1962	116	112	51	49
1963	107	111	49	51
1964	107	115	48	52
1965	57*	80*	42	58
1966	74*	63*	54	46
Second 10 Years	860	774	53	47
Twenty Years	1181	906	57	43

*For 1965 and 1966 the questionnaire responses were even less complete because complete records of researchers were not yet available.

During the first ten years of the ARL's operation 321 out of 453 researcher man-months were logged during the summer, or 71 percent of the total for those years. The comparable figures for 1957-1966 are 860 out of 1634 during the summer, or a drop to 53 percent. The figures for 1960, 1963, 1964, and 1965 show the summer man-months dropping below 50 percent. In the light of other information regarding efforts to establish year-round research projects, it is fair to conclude that over the twenty-year period there has been a trend toward less concentration on summer research. To some degree this probably reflects the diminishing concentration on the biological sciences, which to a greater degree have involved summer activity.

The replies provided information on the length of stay at the ARL on each occasion. The breakdown of the information supplied resulted in the following:

Stay of one month or less	122
Stay of one to three months	341
Stay of three to six months	39
Stay of six months to a year	33
Stay of a year or more	9

The fact that the total of the above numbers is greater than the number of replies is, of course, accounted for by the considerable number of researchers who returned for two or more tours and are therefore counted more than once.

The frequency of returns to the ARL among the 317 answers which yielded such information provided the following:

Number who did not return	156
Number who returned once	74
Number who returned twice	29
Number who returned three or more times	58

These figures are informative and provocative. They show, for example, that more than half (161 of 317) of the investigators returned one or more times to the ARL and, of those who did, more than half (87 of 161) returned two or more times.

The Changing Balance in the Research Program

Questions 1 and 2 were designed to indicate the field of research or activity which had primarily been involved in the individual case. On the basis of the replies on the two points, "For what purpose were you at ARL?" and "What was your primary field of interest," it became possible to assemble a statistical sample. Since the representative accuracy of the cross section provided by the sample cannot be affirmed, the figures are of doubtful value, but overall trends are suggested.

For purposes of making a statistical compilation it was decided to break down scientific disciplines into three major categories, i. e. physical, biological, and social. A fourth category, technical and other, was added to cover personnel at the ARL who were there in a non-research capacity. That category included those using the facilities as a "hotel" and those providing supportive services such as electronics technicians.

The use of the categories was to avoid arbitrariness and misleading conclusions insofar as possible. That was necessary because of the vagueness of some of the responses and to overcome some of the limitations of the sample provided by the respondents. Social scientists were determined to be those whose major focus was man-oriented. That area included those in archeology and the medical sciences. In some areas, such as physiology, there was a possibility of classifying the

researcher under either the biological or the social sciences. The determination was based on whether his focus seemed to be on man or on animals. Generally the questionnaires provided the necessary information.

The other problem area was between the biological and the physical categories in fields such as limnology. Determinations were made on the basis of whether the researcher demonstrated more emphasis on the biological or on the physical factors. While the determinations were arbitrary in a few cases, they involved a very small number of researchers and in most instances it was possible to make a clear distinction.

The statistical breakdown among the four categories was done by year only. In a few cases even a yearly distribution was not possible. Nevertheless, the total number of researchers classified under the categories totaled 330, a number greater than the number of usable questionnaires. The explanation is that a few respondents provided information on other members of a research team, who themselves did not complete the questionnaire. The year-by-year distribution is shown in the following table:

	Physical	Biological	Social	Technical and Other
1947		2		
1948	2	3		
1949	3	3	1	
1950	2	8		1
1951	7	17		2
1952	9	14	2	1
1953	3	17	1	1
1954	5	3	2	1
1955	9	11		1
1956	22	8	1	1
1957	19	13	1	
1958	23	13	1	
1959	23	18		
1960	37	18	1	3
1961	42	26	6	5
1962	45	21	6	5
1963	54	34	1	2
1964	41	23	4	2
1965	28	21	1	
1966	32	20	1	2

The combined sums of the four column totals are more than the number of replies used or the 330 researchers who were classified, mainly because many researchers returned to the ARL one or more times and were therefore repeaters in the compilation. The 330 researchers classified were divided as follows:

140 biological scientists
172 physical scientists
18 social scientists

An analysis of the above table of yearly distribution suggests certain broad general trends. For example, if one divides 20 years into two decades, the first decade, 1947 through 1956, shows a preponderance

of researchers in the biological sciences — 53 percent as compared with 38 percent in the physical sciences. For the years 1957 through 1966 the percentages are almost reversed — 37 percent in the biological sciences and 58 percent in the physical sciences. Researchers in the physical sciences outnumbered the biological scientists in every year since 1955. The reverse was true in previous years, except in 1954. A similar analysis based on the file record is presented in a later section on Summary and Analysis of Twenty Years of Research and confirms the general validity of the sample provided by the questionnaires.

The reasons for the shift of emphasis may not be completely discoverable, but some may be surmised. Among the factors that probably played a part were the following:

1. The early emphasis on the biological sciences reflected in part the fields of professional interest of the Scientific Directors. Drs. Irving and Wiggins were very influential in recruiting and attracting university scientists to the ARL. They were themselves distinguished biological scientists. With the advent of Brewer as Director that situation was changed.

2. Another factor was the deliberate effort on the part of the Office of Naval Research and of the research committees of the Arctic Institute to broaden the research to include disciplines not previously represented.

3. A third factor was the IGY which, although it gave greater attention to the Antarctic than to the Arctic, did spur interest and activity in some of the earth and atmospheric sciences also in the Arctic.

4. The establishment of stations on the ice islands — ARLIS II and T-3 particularly — also resulted in expanded research activity in several physical sciences.

5. The broad impact of the Korean War and the increased strategic concerns in the arctic region during the fifties spurred investigations in many fields, of which the physical sciences were more immediately required than the biological or social.

6. Some of the investigators interviewed, who were themselves in the biological field, have suggested another element — that research programs at the ARL were being judged increasingly on the extent to which they qualified as "mission oriented." The suggestion, which with some carries unconcealed criticism of the trend, was that "pure science" was having to take a back seat and that the biological and social sciences did not have the support enjoyed by the mission-oriented physical science projects.

The statistics cited above reveal clearly the back seat taken by the social scientists in ARL research projects. This is not surprising in view of the sparse population of the arctic area readily accessible

from Point Barrow. Of the 330 scientists identified from replies to the questionnaire, only 18 were classifiable as social scientists. As noted, most of them were in archaeology or medicine. Social psychology also entered the picture.

Confusion as to Sponsorship

Question 3 was a multiple-part attempt to discover facts and judgments regarding sponsorship of the individual's research project and his employment status. Because ONR was the host and primary instigator of research at the ARL, the question was put in terms of ONR or other sponsorship. For projects with other sponsors the questionnaire asked what arrangements had been made with the ARL by the investigator or his sponsor. The question was then asked whether the individual was at the ARL as an employee of his agency or was there under contract.

Unfortunately question 3 yielded untrustworthy and inconclusive results. For example, of the 259 "usable" answers on the point of sponsorship, 107 listed ONR as the sponsor, and 152 gave Other. Some of the Other sponsors listed, for example, were universities, when clearly the university or someone on its faculty was simply the recipient of an ONR or an ONR-AINA grant. A major reason for the confusion on that part of question 3 was that a large number of the replies were from investigators who had been at the ARL as young graduate students or as assistants to a principal investigator. Many of them had paid no particular attention to the technical matter of sponsorship. They knew who paid them, but did not necessarily know

where the funds originated. There was obviously also some confusion regarding the respective roles of the ONR and the Arctic Institute as sponsors of research projects.

The part of the question relating to employment or contract status of the investigators also yielded results that are highly suspect. Of the 123 who attempted to answer, 78 indicated that they had been employees; 31 wrote "contract" and 14 specified "grants." The totals hardly are significant, even if accurate, which is doubtful, because nearly two-thirds of the returned questionnaires did not have any answer to that question and some who answered were clearly uncertain of the correct answer.

Despite the foregoing, many answers attempted to identify other agencies or institutions that had some connection with the sponsorship or operation of investigations at the ARL. The following universities were cited: Cornell, St. Louis, Stanford, Alaska, California, Michigan, Minnesota, Washington, Yale, George Washington, Iowa, Louisiana State and Saskatchewan. Among Other government agencies the following were cited as having supported ARL research projects: Army Signal Corps, Army Map Service, ARPA, CRREL, NOL, NEL, NCEL, CNO, ONPR, AEC, Coast and Geodetic Survey, ESSA, NASA, National Bureau of Standards, NIH, National Park Service, National Science Foundation, Smithsonian Institution, Geological Survey, Public Health Service, Bureau of Commercial Fisheries, and Interior Department. Also

mentioned were the Explorers Club, the National Geographic Society,
and the Nippon TV Network Corporation.

Impact of ARL Experience on the Investigators Themselves

In trying to assess the impact of the Arctic Research Laboratory a first step was to inquire into the effects of the ARL experience on the participating researchers themselves. Most of the questions (4-10) in the 12-part questionnaire were intended to elicit meaningful information on different aspects of those effects.

First, the questionnaire sought to produce information which would indicate how the investigators' individual scientific progress had been advanced as a result of their work at the ARL. Some of the respondents evidently missed the initial word "how" and simply gave a yes or no answer or a brief negative or positive statement. Such answers, nevertheless, were revealing. Of the 287 who answered the question only 36, or one in eight, gave a clearly negative answer indicating that there had been no advance in their own scientific progress as a result of their work at the ARL. Most of the replies gave some assessment indicating "how" their scientific progress had been advanced by the ARL experience. About 252 replies were "positive" in tone.

The points of emphasis varied greatly, as was to be expected. Twenty-one cited publications that had resulted from their investigations at the ARL. Thirty valued the field experience. Thirteen made special reference to the value of arctic experience. Five gave credit for job

placement or advancement to their work at the ARL. A number indicated that the ARL research had been instrumental or contributory in gaining for them an advanced academic degree. Thus 21 indicated that their Ph. D. degree had resulted or partly resulted from their ARL research. Similarly 10 mentioned Master's degrees. Only 4 mentioned that their teaching had benefited. Some mentioned the value of contacts with other scientists. The greatest number (123), however, referred to the field of investigation or the subject to show how their scientific progress had resulted from their ARL work.

One respondent argued that the question was not a good one since he thought that without ARL field support much of the work probably would not have been accomplished. Another simply observed that as a TV cameraman his answer was negative. A skeptical view was taken by one who doubted that his work at the ARL advanced him any more than if he had been assigned somewhere else.

As noted, however, the large majority of responses found reasons to make strong favorable assessments. Some of these may be summarized in order to give some flavor of the reactions recorded.

One indicated that he had used the materials he had obtained both for further research and in his teaching. He had also published extensively. One had been given a psychological boost and also a field of specialization; one pointed out the direct contribution of the ARL research to several

Ph. D. theses; one emphasized the outflow of writings; another made special mention of the value of the T-3 base as essential to his research.

Many replies mentioned specific areas of accomplishment in scientific or other fields. Among these were:

- Environmental physiology,
- Construction methods, later used at Thule, Greenland,
- A new mode of sun-compass orientation,
- New evidence of early New World man found in a previously unexplored locality,
- New discoveries in atmospheric chemistry,
- New materials for paleontology and sedimentology,
- Increased knowledge of submarine features of the Arctic Ocean,
- Initiation of a long range project on snow blindness,
- A better understanding of the ecology of the North Slope biota,
- More oceanographic research,
- Research in trans-auroral HF communication paths,
- Effects of extreme cold on electronic components and circuits,
- Magnetic-observatory operation and measurement of the strength and direction of the earth's magnetic field,
- Distribution of fallout radionuclides in northern latitudes,
- Pendulum gravity observations,
- Marine biology,
- Telluric current and geomagnetic micropulsation techniques,
- Soil-bacteria studies,
- Polio antibodies in Eskimos,
- Radioactivity studies,
- Relic permafrost phenomena,
- Research on lichens.

One person stated that his time at the ARL had been his single outstanding educational experience. He valued particularly his contacts with other investigators and said he had received a dinner-table education at the ARL which could be described as a university in a quonset hut.

Career Influence

The fifth question sought to uncover the extent to which the careers of the researchers had been affected. Many of the investigators questioned were relatively young who had not as yet had a "career" and could not at that stage make more than a guess as to how much the ARL experience would ultimately affect their career. Even for them, the replies were indicative, even if not decisive.

On a simple yes and no basis as to whether or not their careers were influenced the answers divided almost evenly. One hundred and forty-three wrote "yes"; 140 wrote "no." A few gave unclear answers because the question did not fit their particular cases.

Some of the "no" answers had special reasons attached. For example, one indicated that he lives and works in the Arctic. One wrote that he had retired as soon as he left the Arctic. One wrote that he would like to return but had not. Another confessed it improved his scientific background and indirectly influenced the information he could impart to his students. One affirmed that it increased his interest in reproductive physiology. Other "noes" were more strongly negative. For instance, one had been taught to stay out of such remote areas. One who evidently had a close call of some kind responded to the question by the stark assertion that, on the contrary, his career had nearly been cut short.

Another wrote that it killed any desire to work in the Arctic.

Some of the "yes" replies were qualified. One reported that since his career is only beginning he does not know as yet, though he has always had a great interest in the Canadian Arctic. One researcher answered that he was working on a Ph. D. on Arctic Ocean Geophysics and had a great interest; that things might change later. Another referred wistfully to the wonderful land of Eskimos and the midnight sun, to which he would like to return.

Among those who gave definite "yes" answers a variety of exemplifications were recorded. For example:

One found that his ARL experience had focused his work on environmental problems. His graduate students had been influenced by this.

One had spent most of ten years working on the materials he had collected at the ARL.

One had spent four years largely devoted to the study of arctic soils; another proposed to continue his work in glaciology.

One attributed to his association with the ARL a direct contribution to two-thirds of the papers he had published since being there.

Several indicated that their interest in arctic research had been aroused and confirmed by their first experience at the ARL.

One had found the Arctic the most interesting of oceans; another had plans for ten more years of research in the region; and another was on a constant lookout for chances to return as often as possible.

Several emphasized the uniqueness of the Arctic as a biological laboratory and the value of their work in arctic ecology.

In addition to replies like the above which attributed to the ARL experience a definite career impact, there also were a number of answers which credited the ARL with an indirect influence on choice of career. At least 9 of the replies carried that implication. One other wrote that he hoped to do future work in the Arctic and two found that their careers had been influenced to some extent. One reply, turning the table upside down, indicated that his stay in the Antarctic had influenced him to go to the Arctic, where he has been working on T-3.

Contribution to science at lower latitudes

Question 7 was aimed at throwing some light on the individual researcher's evaluation of the geographic transferability of techniques, comparability of data, or other relationships between the Arctic and lower latitudes in terms of particular scientific disciplines.

The replies to the question were not all clear cut, but, based on the words used, the answers fall into the following groups:

Not answered, inapplicable	63
"Moderately"	131
"In a major way"	88
"Not at all"	40
Total	<u>322</u>

If the first 63 are dropped out of consideration, 50 percent of the remaining 259 found a "moderate" contribution, and 35 percent thought the work at the ARL made a "major" contribution to their discipline in the lower latitudes. The remaining 15 percent answered "not at all." Among those who found the question inapplicable one wrote that one does not study sea ice in lower latitudes. Another found he could only give a negative answer because he found the Arctic little different from his experiences in northern Minnesota. A third, whose field included glaciology, found that he had been aided in the interpretation of late glacial conditions farther south. One respondent turned the question upside down and replied that the situation was really reversed. As a man working in marine

biology he had tried to use techniques from the lower latitudes in the Arctic.

Most of the replies did not elaborate on the simple choice between "moderately," "in a major way," and "not at all." Some did give a brief explanation. A sampling of these will throw some light on the types of lower-latitude application of arctic research. It appeared from the replies, and particularly from the comments offered, that those most greatly impressed by the applicability of arctic studies to lower latitudes were the biologists.

Several replies mentioned the value of arctic ecological studies to similar studies in other latitudes. One went so far as to offer the opinion that every ecologist should be exposed to the arctic or alpine environment. That comment was perhaps explained most clearly by one who felt that ecology had benefited enormously from arctic research in the past. He had found that much early insight into community structure grew out of arctic work. Because of the relative simplicity of arctic communities he thought that work in tundra ecosystems greatly contribute to results of general application. One respondent could not see how anyone could evaluate arctic ecology without having worked there.

Comments on specific aspects of biology illustrated the areas in which comparison was thought to have been useful. For example, one mentioned the shallow-water sponge fauna and its relation to that of

the Pacific coast of the U. S. and Canada. One found similarities in species and in general vegetation between the Arctic and alpine areas of places such as Oregon. A researcher on the taxonomy and ecology of lichens asserted that his work had given much new information on distribution and had resulted in the identification of several new species. An investigator in ichthyology and cryobiology found that data on the North dovetails with that on temperate and tropical areas. A well-known scientist in the field wrote that his work at the ARL was a real contribution to his studies of the marine animals of the world. One who had studied the wolverine as a typical arctic carnivore wrote that the species studied ranges from the temperate zone to the Arctic.

One mentioned concepts of world vegetation zones and climatic changes. An anthropologist found it pertinent to mention early-man materials in the new world. One who had made a population analysis of insects found the arctic studies useful, especially for comparisons of arctic forms with their relatives at lower latitudes in places such as the high Rockies. An investigator of plant ecology and soils found the arctic ecosystems fascinating. Another researcher summarized his view that field work allows one to generalize in theory. Theory, he thought, is not confined to certain latitudes. A practical approach was taken by one respondent who gave a positive answer, he said he had been given experience in field work and had acquired data to use in teaching

and writing. A biologist found that comparisons are being made on morphology and physiology of arctic organisms with those from temperate regions. The transfer of arctic techniques or principles, however, was not confined to the life sciences.

The fact that the investigators most impressed were in the biological sciences is perhaps not surprising. Other disciplines apparently were less obvious areas for comparison involving the Arctic and the lower latitudes. Some who worked in other fields also checked moderate or major contributions, but did not explain further.

Permanent interest in arctic research kindled

Aside from the narrower questions concerning the career effects or the effects on scientific advancement there was another possible, more general, individual effect that seemed worthy of a probe. It concerned, broadly, the question of the extent to which a lasting interest had been kindled in arctic research. For many the formulation of the question was not the most applicable. In many cases the interest obviously had been kindled before, not after, the scientist spent time on a research project at the ARL. That was clearly reflected in several responses. Of the 292 who answered the question, 37 replied, in effect, that they already had the interest. Oddly enough, those who previously had the interest seemed incapable of considering the possibility that they might subsequently have lost it.

Of the 255 whose answers amounted to a "yes" or "no," the overwhelming majority voted "yes." Of the 255 there were 197 yes answers and 58 noes. In other words, more than 77 percent recorded that a long-term or permanent interest had been kindled.

Many of the replies to the question went beyond the plain "yes" or "no." The affirmative as well as the negative answers reflected varying degrees of intensity of interest or disinterest. One of the latter answered that he preferred to work in the tropics. Another as an indication of his disenchantment, said that his arctic work had killed his interest. On the

other hand, most of the elaborated replies were on the positive side. Some echoed the thought — once an arctic hero, always an arctic hero. One wrote that he only wished he could afford to continue with arctic research. Another answered that his arctic experience had kindled a permanent interest in remote places and in places with the kind of natural geography found in the Arctic. Other answers expressed continuing interest for a variety of reasons. One regretted that he had never had the opportunity to spend a winter at the ARL; one thought that he would be in line to apply if married men could bring their families; one was impressed by the sophistication of recent work on tundra biology; one was encouraging his students to pursue cold-region research; one regretted that his teaching did not permit him to go; some asserted that their interest was reflected in their reading even if they were unable to pursue their own arctic research. One asserted that his interest had definitely been kindled and he was about to begin a long-term study of body-heat regulation that would probably take several years.

In summary, it appears that about four out of five of those who replied have a favorable and positive attitude toward the Arctic and toward arctic research. In some cases this attitude pre-dated the ARL experience and in some cases the interest probably grew out of some affinity for the polar environment. One person, for example, replied by giving the credit to the tundra, not to the ARL. Another indicated

that his ARL experience had not only kindled an interest in arctic research, but in antarctic research as well.

Graduate degrees and dissertations resulting from ARL investigations

In attempting to assess the impact of ARL research projects on the careers of the investigators themselves it was considered significant to discover the facts regarding graduate degrees that had been earned to a significant extent on the basis of work done at the ARL. Similarly, some of the research products presumably took shape as dissertations presented in partial fulfillment of the requirements for such advanced degrees. Question nine attempted to elicit pertinent answers by asking the respondent to report such information on fellow researchers at the ARL. It was soon apparent from the replies received that the questions, as framed, would not yield the information desired with complete reliability. A direct question to the researcher himself probably would have been more productive. Despite this, significant information was reported, at least on one part of question 9. The information of value related mainly to the graduate degrees earned on the basis, in part at least, of work done on an ARL project. Many responses reporting degrees earned by other researchers were clearly based on recollection or hearsay that may not be completely reliable. On the whole, however, there were enough cross-checks to indicate that the results, although not simon-pure, did provide a meaningful statistical product.

Of the 322 "useful" returned questionnaires, 118 either answered

"no" or "none," or attempted no answer to question 9. The remaining 204 returned questionnaires attempting to give answers. A few reported that they themselves were "young researchers" of their party and gave no further reply. Many did not go beyond an indication that there had been others in their research group. The most useful part of the replies related to the earning of advanced degrees by those who had been at the ARL and who had used the findings of their research in partial fulfillment of the graduate degree requirements.

The replies to question 9 plus the direct replies under question 3, after duplications were eliminated, produced the following results in terms of degrees earned, or in progress, in which research at the ARL had been a contributing element to a greater or lesser extent.

Ph. D.'s earned	44
Ph. D.'s in progress	7
Ph. D.'s (ambiguous information)	3
M. A.'s earned	3
M. A.'s in progress	1
M. S.'s earned	23
M. S.'s in progress	5
Master's degrees, unspecified	6
Master's degrees in progress or ambiguous	2

To summarize, the above table indicates a total of 44 doctor's and 32 master's degrees earned and seven of each in progress, plus four others whose exact status was not clearly revealed. In most instances the total role ARL research played in the earning of an advanced degree was not revealed, but it was apparent that in a great many cases it constituted the core of the research on which a thesis was based.

The replies to question 9 yielded little useful information on theses written on the basis of ARL research or on the publication of such theses. More of the replies did mention the institutions at which the advanced degrees were earned, but that information presumably was also fragmentary. Assuming that the replies given were correct, the results showed advanced degrees earned at 28 colleges or universities, including 24 in the U. S., three in Canada, and one in Japan. The institutions cited were the Universities of Washington (6), Wisconsin (5), California (4), Southern California (4), Yale (4), Alaska (2), Iowa State (2), Stanford (3), Columbia (2), Hokkaido (2), Tennessee, Maine, Harvard, Minnesota, Penn State, Catholic University, McGill, Michigan, Rutgers, Michigan State, Indiana, Alberta, Saskatchewan, Fordham, and the University of Denver. Also mentioned were California Institute of Technology, Smith College, and San Diego State College. It may be assumed that the list of institutions, impressive as it is, does not include all that might have been included.

Despite the doubtful accuracy of some of the answers, it is believed that most of the information received is correct. If so, the results are impressive — 84 degrees, including 44 at the doctorate level. One should also bear in mind, a factor which was mentioned by several investigators during personal interviews, that the lack of assured continuing financial support at an early stage of ARL research dissuaded many from attempting a project of Ph. D. dimensions. For many the annual scheduling of research was cited as a handicap. That, of course,

was not true in many other cases, in fact one principal investigator expressed his skepticism of this explanation and said that he proceeded on the basis that if the interest and subject were genuine the means for continuance of the research would be found.

Those who did not return

Question 10 was a continuation of question 9 concerning the "young researchers participating in your project." Question 10 asked how many returned to the ARL to carry on work there, how many did not, and why not.

As with question 9 it was evident that the third-person approach misfired and the results were meager and probably are not too trustworthy. Most persons did not answer the question at all. Many who did were evidently not too certain of their facts. The replies named less than 130 and about half of those were said to have returned. The replies to question 1 gave a far more complete picture of returns to the ARL.

Some of the replies to the "Why not?" part of the question were of interest, but again the respondent was describing someone else and in many cases was guessing at motivations or causes. Nevertheless the reasons reported gave some indicators of apparent validity.

One group of reasons given for non-return to the ARL was dissatisfaction with the first experience. Among the reasons for this were:

They didn't like the hardships.

They didn't like the weather.

They disliked field conditions.

They lacked interest.

They lost interest.

They lacked motivation.

The working conditions were difficult.

The delays imposed by both the environment and certain administrative policies were too frustrating.

The comparative salaries of the research people to others working in the area were too low.

Another type of reason given in a number of cases was a change in interest or field of work. The factors which may have brought about the change in interest away from arctic research were not divulged in most answers. However, one reply, after mentioning some who had not returned, related this to the added frustration and apprehension associated with developing and gaining support for work in the Arctic.

Another reply had a slightly different emphasis, relating the failure of researchers to return to a lack of well equipped field stations and the primitive living conditions. More typical, however, were the replies which did not mention attitudes toward the Arctic but referred to other jobs, employment in industry, thesis problems, and other distractions.

Another type of reason enumerated was financial. One found it difficult for Japanese students to get necessary travel grants, one mentioned the lack of any guarantee of being able to return to the field. Several replies mentioned lack of assured financial support.

Two mentioned the ending of their projects; one mentioned illness,

one listed prior commitments, and two referred to the effects of marriage and the difficulty of leaving a family for three months. One mentioned military service.

The above responses are not necessarily the accurate ones in some cases, and one may surmise that there were many reasons not given in the replies.

The Impact of the ARL

Question 11 was designed to draw out comments and reactions of investigators and others who had worked at the ARL in order to evaluate its total impact in the judgment of those who had been there. In view of the great individual differences among those queried in their fields of investigation, the durations of their stays at the ARL, as well as the years they were there, and a host of possible personality or other differences, it could be assumed that the replies would be a very mixed bag. That proved to be the case. In order to provide a cross section of views on some specific areas where the ARL might conceivably have been thought to have had some impact and also to stimulate responses, the questionnaire listed several such areas as suggestive. Included were: the Navy, other government agencies, the universities, national defense, science, and national and international impact. Finally, the question asked the investigators to list the strengths and weaknesses of the Laboratory.

Many of the responses were general statements with little or no further elaboration under the sub-headings of question 11. Many of the comments were similar to some of the entries under the "Strengths" part of the question. For example:

One suggested that ARL has been carrying the ball on arctic drift-station research since the withdrawal of the Air Force; one cited the new

fields of research opened up; one thought the ARL was a principal element in catching up with the Russians; one thought that support of research by government agencies including the military services had benefited all. Other comment was very brief, using terms such as beneficial, excellent, significant, comparative studies, pure research a necessity, much needed, enhanced arctic development, etc. Several of the entries mentioned logistic support for arctic research as a valuable contribution. Others stressed the view that the ARL made possible research which otherwise would have been impossible.

Impact on the Navy

Of the 322 who answered parts of the questionnaire meaningfully, 90, or 28 percent, had something to say about the impact on the Navy. Some were lukewarm or pessimistic in their replies and found little impact. One respondent, who identified himself as an old Air Force man, admitted that he did not have the foggiest idea. He hoped the impact had been salutary. Another hoped that the ARL had been an insignificant nuisance. Even more negative was the estimate of the one who thought that the ARL had been a waste of money. He thought that, given proper leadership, the ARL could be of great assistance. Such responses were not typical, however.

Of the 102 separate points made by the 90 who made entries under the heading, 24 directly addressed themselves to the impact of the ARL on the Navy in terms of naval operations.

Among the impacts cited by one or more of them were such references as aid to atomic submarine operations, providing knowhow for the future, training in resupply operations, training for frogmen, providing basic information on arctic environments, good testing ground for equipment and men, knowledge of ice structure, thermal gradients in permafrost, survival methods, scattering layer, under-ice conditions important for ASW operations, good location for Naval Oceanographic Office, Bureau of Yards and Docks, and NCEL research, increased knowledge of the

Arctic Ocean and of the geology of the Petroleum Reserve, and a fine facility for conducting applied research connected with operational problems of the Navy.

Many of the responses (23) referred to ARL contributions to the Navy but in senses not bearing so directly on naval operations of the usual type. For example, one thought that the ARL was a worth-while public-relations expense; two thought it enlarged the Navy's reputation in scientific fields; one thought the reputation of the Navy had been enhanced; and one thought it had given the Navy a sense of purpose in peacetime.

Other general comment mentioned enrichment of the Navy organization; the value to the Navy of associating with independent scientists; the feedback of scientific information such as underwater environment, sea ice, marine ecology, etc. On a slightly different tack, one cited the "dilution of the Navy brass" as an ARL impact. Another thought the ARL operation had given the Navy a more realistic tie with technical, scientific, and business life.

Roughly 88 of the 102 comments were positive, most rather strongly so. There were, however, a few who were not impressed. Some of them were mentioned above. A few others also made pessimistic comments.

One thought the Navy was too big for the ARL to have made a

dent; one thought the ARL a stepchild, except in ONR; some found the interest in the ARL slight and its impact also slight; one thought it kept some of the Navy busy in peacetime; one thought basic research could not be expected to have much impact; one was saddened by the lack of comprehension that the research had which was actually relevant to tactical and strategic problems; and one, who found little or no impact on the Navy, thought this to be not surprising because the ARL was neither an area for routine operations nor was it expected to give direct support to such operations.

Impact on other agencies of government

The number of respondents who made an entry under impact on other agencies was nearly the same as the number who commented on ARL impact on the Navy; 90 on the Navy and 96 on other agencies.

Of the 96 who commented, only 21 referred to the other agencies by name. Thirteen agencies were named as beneficiaries of the ARL's existence and operation. These included the Geological Survey (mentioned in 11 responses); the Bureau of Standards (named by 3); the Public Health Service (3); the Coast and Geodetic Survey (3); the Interior Department (4); the Air Force (5); the National Science Foundation (3); ESSA (2); the Army (3); the Weather Bureau; the Department of Defense (2); NASA (2); and the Atomic Energy Commission (2).

The comments offered credited the Navy with having blasted other agencies out of their lethargy; with having provided others with a place to work; with enabling others to consider projects that would have been unthinkable but for the ARL; with having made it possible to get weather information, to operate a magnetic observatory, and to put up a rocket range; with making life much easier for the Geological Survey, especially in training high-latitude geologists; and finally, one credited the Navy with having forced other agencies to realize that the Arctic exists and that much remains to be done there.

In 58 of the responses in which no specific agency was named, the responses contained some form of favorable comment on the ARL contribution to other agencies. Some of these were brief, such as "positive impact," "favorable," "very useful," "beneficial," "quite useful," "mutually beneficial," "general benefit," "moderately," and "greatly facilitated."

Others mentioned particular fields or areas of research in which the ARL was helpful. Among those cited were: marine and terrestrial research, zoonotic diseases, human ecology, wildlife management, radioactive fallout from weapons testing, conservation, survival studies, heat-budget work, meteorology, life sciences, and geography. Also mentioned was work on the coastal plains, on the beaches, on drifting stations, and concerning Eskimos.

Other generally favorable comment cited logistic support, broad research emphasis, stimulation of pure research, readiness of the Navy to support any federal agency, and the value of being able to do the research on U. S. territory.

A small number (12) were less than glowing in their comments. Some were regretful, others were laconic. Among the terms used were slight, nil, little, small, not significant, and insufficient. Some who found little impact expressed regret that this was so and thought this undeserved. One compared the arctic situation with that in the Antarctic

which has attracted much more support and attention.

One who had indicated his view that the ARL had had slight, if any, impact on the Navy found that the impact on other agencies was even less.

Impact on universities

About half of those who commented meaningfully on the questionnaire had something to say on the evaluation of the ARL's impact on the universities. Of the 322 responses 159 wrote something under that heading. Of the 159, all but 17 were definitely favorable and positive in their answers. Of them, 19 were brief and general. The descriptive terms used were such as "good," "considerable," "very good," "especially good," "greatly facilitated," "in a major way," "considerable and beneficial," "very great," "tremendous help," "excellent," and "tremendous."

Of the 159 responses, nearly a third (46) might be characterized as general comment relating largely to the impact of the ARL in stimulating interest in the Arctic and providing research opportunities there, with some mention of the positive effect on university teaching. Some mentioned particular universities which were most involved. Among those mentioned were the Universities of Alaska, California, Washington, St. Louis, Wisconsin, Tennessee, and Rutgers. The comment referred to such favorable elements as aid to research, aid to teaching, interest generated in the arctic, absence of discrimination against great or small universities, increasing stature of some universities because of research publications, and spreading of interest in arctic research.

In addition to the more general comments cited, there were numerous

(36) responses which emphasized the value of the ARL to university students, especially graduate students, and to faculty members. Some mentioned especially the opportunity for research leading to the production of theses and graduate degrees.

There appeared to be an especially keen appreciation of the opportunities which the ARL had opened to both faculty and students — but especially to graduate students — to do field research in the arctic environment. That appreciation was further spelled out by some who wrote more directly about the logistic support and the financial aid which made possible the field research out of the ARL. Sixteen of the responses mentioned the support facilities of the ARL and 8 others mentioned the financial support upon which many universities depend. An additional 21 phrased their tributes in stronger terms. The flavor of those comments was uniform.

Especially stressed in those responses was the theme that the ARL's existence made it physically as well as financially possible for the universities to encourage their graduate students and faculty to do valuable field research in a variety of disciplines. Also emphasized by some was the unique opportunity provided by ARL for centralized research on T-3.

The views should be read in conjunction with the answers given to that part of question 3 which asked whether there would have been

alternative ways of accomplishing the work if the ARL had not been in existence. Half of those who replied to question 3 (88 of 178) said "no." On the probable cost of alternatives, 93 answered the question. None of them thought the alternative would have cost less; 13 thought "the same;" and 60 thought "more." The additional cost would have been prohibitive in the opinion of 22. Similar judgments appeared in many of the responses to question 11.

Not all the comment on ARL's impact on universities was as strongly favorable as most that have been cited. However, of the 17 responses that might be listed as skeptical or reserved, or even "negative," the tone of the comment was in most cases not condemnatory. One of the respondents thought that the impact was felt only by the university which held the supporting contract. Another found the impact less than it might be. He thought that only a few universities were aware of the facilities of the ARL. One found no impact on the universities as such, but only on individuals participating; whereas another thought there was a moderate impact on a handful of universities. One found the impact spotty, but cited strong impact at a few places such as Alaska, Washington, California, and Wisconsin. One thought there was little impact except on the specific scientific fields included, while two asserted that few universities were interested or used the ARL. He suggested that liaison and public relations are lacking. One investigator

concluded that the ARL was only of moderate importance to the universities, and another simply recorded a question mark. One found the impact small because the projects were mostly on an individual basis. Another charged that arctic research is an "in-group sort of thing."

A tone of cynicism crept into three responses. One noted considerable paid vacationing; another, in the same vein, wrote that it gave a few professors something to do in the summertime. Most negative was the one who admitted to having an unfavorable reaction, which he ascribed to a feeling held at the ARL that the researchers were a nuisance.

On the whole the answers to that part of question 11 were rather strongly favorable and enthusiastic. As had been indicated, many of the respondents realized that the ARL had made possible, through its facilities and logistical support, as well as by financial assistance, the participation of the universities, both faculty and students, in the arctic research. The responses also indicated an awareness that the number of participating universities was not as great as might have been.

Impact on national defense

Of the 322 "completed" questionnaires only 93 had any comment under impact on national defense. Of those who did it was evident that many felt ill at ease with the question and had no enthusiasm for trying to answer it. Despite this, a number of perceptive comments did appear and in total added up to an impressive collection of cited gains for the national defense.

Seventeen respondents chose to provide an overall evaluation in the briefest fashion, although they did give a positive judgment. Typical terms used were:

Importantly helpful.

Catching up with Russians.

Small but important.

Very important.

Great impact.

Moderately.

Good.

Has helped significantly.

ARL a good thing.

A big assist.

Positive influence.

Potentially crucial.

No question.

Benefits seem obvious.

Much basic information.

Probably.

Of the 93 who responded, 18 chose to do so in rather broad terms, most of them relating the ARL's defense contribution to its location in an area which is, or may become, important to national defense.

One asserted that the ARL provided an essential stimulus to needed research for vital arctic information. Another generalized this in terms of providing us with know-how in polar areas. One found that the ARL's very location made it highly important to national defense, while another concluded that, if the U. S. ever faced across-the-pole military operations, they could be dealt with with greater confidence than in 1950. Also on an area basis, another concluded that with the advent of nuclear submarines the Arctic Ocean is one of our regional defense areas. Similarly, one wrote that in an area so near Russian experimental stations we certainly cannot know too much. One respondent offered the intriguing thought that the ARL is not of strategic value but is perhaps of political value. He did not elaborate.

Some of the general comments were tied more specifically to activities at the ARL itself. One mentioned that there were many studies connected with national defense. One cited our better understanding of

physical conditions and resources; another surmised that some of the research could prove to be of major importance if certain (presumably military) conditions arise. Drawing on his own experience, another researcher believed that the success of nearly two years of defense-directed research was made possible by the ARL. One took a broadly optimistic view and assumed that a high percentage of research performed at the ARL may eventually have some effect on national defense. Finally, one respondent offered a somewhat cloudy observation citing the creation of wide knowledge among key defense institutions regarding the changing significance of the whole northland.

More than a third (36) of the responses referred in specific terms to different aspects of the national defense impact of the ARL.

Of them several mentioned oceanography, underwater research, and ice-island research. The underwater-sound research projects were cited by 3; studies of the "ocean bottom profile and gravity measurements" were cited as giving aid in Polaris submarine navigation; and one thought the ARL was the place for learning problems of undersea transport across the Pole. Three persons referred to the significance of T-3 and the other ice islands, partly because of projects there, and partly because of the important geographical position of T-3. One mentioned learning about the bearing strength of ice for landing by aircraft.

The range of other specific defense-impact aspects of the ARL

that was reported in the questionnaire may best be indicated by a listing of abbreviated summaries of several replies. The answers were non-repetitive to a surprising degree. Among the aspects mentioned were the following:

CCREL research indicative.

DEW Line operation and support for DOD work.

Increased knowledge of environment on a potential military front.

People who have worked there are potentially important.
(3 replies made this point.)

Supplied considerable resource data relative to survival and tactical applications.

Allowed us to study the problem of logistic defense in a hostile terrain.

Large volume of knowledge on physical, biological, and technical conditions and problems.

Understanding of vegetation and permafrost.

Polar communications and problems of polar survival.

Effects of low temperature on animal functions.

Studies of radioactive fallout may be of extreme importance in the future.

Survival in the Arctic (2 replies made this point).

Better understanding of tundra.

Radar station - its very location.

Submarine operation.

Place for learning problems of missiles.

Arctic oil.

Siberia joins North America here.

No less than 23 of the 93 who gave responses found little or no ARL impact on national defense, or at least knew of none. Since the replies were in some cases hesitant and uncertain, one may suspect that some of the investigators had given little thought to this aspect or were for various reasons indifferent to it. The flavor of the comment was one of skepticism.

Minimal impact - principal value is in research efforts.

Does it matter?

Question is out of line - not comparable.

Minimal.

None known. (2 replies)

Slight.

None.

?

Some effect but not much.

Not too significant.

Probably very little due to changing world situation.

Of minor importance so far. (2 replies)

Not sure.

Doubt important relationship.

It's easy to overrate this.

One respondent was inclined to doubt whether the ARL should be connected with the military. Another, who also presumably had some critical thought, charged that in the Cuban Crisis military logistic forces were diverted by the ARL crisis. The thought was not elaborated.

Impact on science

Because the Arctic Research Laboratory from its beginning has operated as a support center for research in various fields of science it was not surprising that many of the answers to question eleven had comments under the heading of Science. In total 165 of the 322 commented. Indirectly, of course, some of the remarks made under other subheadings also reflected views on the impact on science.

Of the replies, several took occasion to stress their strong views that the ARL is a unique institution and had been an indispensable, or nearly indispensable, center for scientific research in the arctic environment. One emphasized that for a long time the ARL was the only facility of its kind on the North American continent. One wrote that it was the only U. S. base for arctic science, and another went so far as to assert that it was the only scientific facility of the free world in the far North.

The view was taken in several answers that without the ARL it would have been difficult if not impossible to have carried on the scientific research program in the Arctic. That thought was expressed in different ways by 13 of the entries. One contended that there had been little American and Canadian work in the Arctic without involving cooperation with the ARL. One felt that the impact had been tremendous. Scientific research in the Arctic was almost impossible without the ARL, he thought.

One repeated the theme that the ARL permitted research impossible otherwise. Another dramatically charged that without ARL it was doubtful if 1/100 of the research work which had been conducted would have been started. Others agreed that the ARL had made possible arctic scientific research which would otherwise have been largely impossible.

About 22 of the replies placed major emphasis on the impact which had been produced by the gathering, and particularly by the publication, of scientific information which had been the result of research at or out of the ARL. The flavor of the replies is indicated by the following samples:

Information benefited science in general.

Greatly increased knowledge and awareness.

New problems generated, knowledge increased.

Publication of scientific research material out of ARL makes scientific community aware of problems of the Arctic.

Many papers published.

Publications speak for themselves.

List of publications will show that.

Gained immeasurably from the interest and information gained at ARL.

Important contributions in many areas of high latitude science.

Some fine research - of much value to mankind.

A vehicle for accomplishing many important projects.

ARL gets more science done per dollar than any other agency.

A slight variation was the emphasis by some on the effect of the ARL in promoting interest in, and conduct of, arctic scientific research.

About a fourth of the comments were very brief favorable comments of broad impact. Typical words used were "important," "very important," and "most important." Other terms used were "rewarding," "obvious," "significant," "very good," "positive," "definitely good," "unmeasurable," "far reaching," "considerable," "tremendous value," "excellent," "beneficial," "very great," "very helpful," and variations of such expressions of approval.

As could be expected, a number of those questioned cited the impact of the ARL on specific disciplines or areas of scientific knowledge. The comments made were summary evaluations. More complete answers would have been of greater interest, perhaps, but even the brief replies of the 33 who mentioned specific scientific fields gave a flavor of the estimated total impact.

Of the several areas of scientific investigation the most numerous mentioned were those relating to arctic or tundra ecology. The term "ecology" or "ecosystems" was used in six responses and other terms were closely related. That view was explained on the basis that arctic

communities are very simple and therefore easy to study. One made the point that a study of tundra ecosystems had value also for other areas. Another contended that clarification of the arctic ecosystems permits insight into complex temperate and tropical ecosystems.

In total, the life sciences received greater attention than others. Typical of such comment was one which claimed a major effect, long range, in areas of arctic physiology and biology. One stressed biochemical and physiological studies; many others mentioned the general field of biology; others mentioned studies of the flora and fauna; one cited the unique bench-mark region for comparative studies in a wide variety of natural history interest; while others referred to more specific studies of the arctic fauna. Mentioned in that connection were studies of the life and habitat of the polar bear, whale studies, studies of birds, and particularly lemmings. One mentioned the Schultz and Pitelka hypothesis of arctic fluctuations in animal populations. Pitelka's studies also were praised by others.

Three responses referred to the studies of soils. One affirmed that Dr. Tedrow's classifications gave the world's best picture of arctic soils.

Investigations in the fields of health, medicine, archaeology, and anthropology were mentioned, as well as marine environment.

Among the physical sciences referred to were oceanography, gravity

studies, physiography, astrophysics, geophysics, geomorphology, meteorology, ionospheric physics, and limnology. One reply affirmed, for example, that data from the Barrow ionosphere station are used by researchers around the world. It would appear, judging from the comments made, that the investigators in the life sciences were either more impressed by the ARL impact in those sciences or else the physical-science researchers were reticent or modest in their references. The more meaningful explanation for the rather scant entries on specifics probably was that the space provided for the replies caused most respondents to confine their comments to broad generalities.

Some of the replies were of a different slant. One, for example, asserted that the ARL made northern Alaska one of the great centers for scientific investigation of arctic phenomena of all sorts; one averred that it permitted field work at any season, hence Barrow was well chosen; another stated that the ARL expanded science from its usual north-temperate orientation; while one was pleased that the ARL permitted limited-resource projects.

In order to round out the picture, it is necessary to mention those respondents who were more moderate in their praise. Most of them were not negative comments, but their restraint was evident. The following list paraphrases some of the comments offered:

Significant, but still too small.

Moderate.

Of moderate importance.

Small, but worthwhile.

Beneficial, but less than it should be.

Good, but too little marine biological work and general lack of oceanographic interest.

ARL enabled the USA to field an arctic team, but it wasn't of Olympic quality.

Misleading in mammalian studies.

The research effort supported by ARL has been too small and of too short duration to have had much of an impact on science.

Oh come on!

Knowledge increase more a compliment to individuals concerned than to the Laboratory.

Little except on phases of science being dealt with.

Very little - a fantastic potential if properly run.

To discourage good researchers so much that they will go somewhere else, if possible, leaving many unqualified people to carry on projects out of Barrow.

In summary, the weight of the responses was heavily on the positive side, and the negatives were very few or of limited coverage.

National impact

As might have been anticipated perhaps, the query about the national impact of the ARL drew relatively few comments (84, or about one fourth), and there was some uncertainty of reaction as well as overlapping or repetition of answers given to other parts of question eleven.

Most of the strongly favorable responses were broadly stated. Three replies pointed out that the ARL is a unique U. S. facility in the Arctic. One called it a national institution. One said it should be expanded for both scientific and economic reasons.

Three others stressed the effects of publications and publicity on increased national interest in the Arctic, as well as understanding of it. Four others emphasized the national importance of the knowledge of arctic environment gained. Three respondents felt that it had been a national gain to bring together at one laboratory the scientists from different parts of the country.

Seventeen replies laid major stress on the research benefits to the nation. One feared that without the ARL the U. S. would not have had much basic research in the Arctic. Another concluded that the U. S. now has, thanks to the ARL, significant numbers of well qualified polar scientists. Special mention was made of tundra research, ecological studies and basic research.

A different assessment was made in one response which found that

the ARL had some effect on development - even tourism - and that we had found that the resources were fewer than once thought. Another summarized his view that the ARL makes us aware that we have an unusual territorial advantage.

Eleven of the generally favorable replies were content to use terms such as "great," "significant," "outstandingly important," "facilitated research," "yes," "positive," "beneficial," "good thing," "excellent," and "can't miss."

Three replies referred specifically to the ice islands. One asserted that the ARL is nationally famous for ice-island operations and another thought that the ice islands are of significant national interest and have been publicized.

Eight of the entries made a specific point of mentioning the State of Alaska in this connection. One believed that the ARL had helped the average American to understand Alaska; 2 believed that more people had become aware of Alaska and its potential; one thought that every part of our country should be studied, and that the ARL allowed this for Alaska. One stressed the direct benefit to the State of Alaska of some of the research at the ARL, and another mentioned that there was some benefit to the native population.

Of the 83 who replied, 23 gave qualified or restrained comments on the national impact of the laboratory. Most negative were such responses as "nil," "small," "little impact," "of minor importance," "little," "a

ripple," and "this is taking ARL a little too seriously." Of the others, one thought that the general public doesn't know much about it; 3 others agreed that relatively few know of it or its purpose; one found the impact was only indirect, because the U. S. is not north-oriented; one felt that the ARL enjoys greater international than national esteem. Taking a different tack, one felt that the impact is nothing earthshaking at present because there is not enough economic gain to interest the public. Finally, one who took a slightly different, but also a pragmatic view, concluded that ARL was of perhaps small value - otherwise more public financial support would be given to it.

International impact

As was to be expected, most of the investigators who completed the questionnaire did not offer comment under the heading international impact. Of the 322, 89 ventured opinions as to the international impact. On the whole, however, the comments were offered with greater self-assurance than those which undertook to assess the national impact. One did admit that he felt unsure of this, and another wrote that it was hard to judge the international impact, because only a few nations have an interest.

Of those who offered an opinion, only 3 were unable to find any such impact. One found the impact of minor importance, one found it small, and, one who had written that the national impact was "a ripple," thought the international impact was "a smaller ripple." Two thought the impact moderate. One felt that the ARL was not as valuable as it would have been if more effort had been made to make it an international laboratory. All the other responses were positive, in varying degrees and for a variety of stated reasons.

The largest group of replies (23) cited the use of ARL facilities by foreign researchers. Typical of such comments was the claim that foreign investigators are a sign of international cooperation; that the ARL is a crossroad for scientists of the world; and that the ARL has hosted many scientists of international fame. Other replies referred to researchers who have come to the ARL from Japan, Sweden, Belgium,

France, Canada, and England. Some regretted that there had not been more effort to invite researchers from other countries. Fifteen responses found the international impact in the fact of exchange and sharing of information which had resulted from research at the ARL. Some valued that highly.

Sixteen of the 89 replies praised the ARL as a significant fact in enhancing the U. S. reputation in the field of arctic research, or in giving it greater prestige internationally. One of them went so far as to affirm that the ARL is probably the best laboratory for arctic research in the world. Another concluded that the ARL established the U. S. as a major element in arctic research. One referred to the intangibles associated with stature in the Arctic, and another thought that the ARL made us competitive with other nations in the area. Three of the replies stressed that foreign scientists have become aware of, and greatly respect, the ARL and its staff for the contribution made to arctic research. One believed that the ARL gave us position and authority in a shared region of importance.

As could be expected, some (9) of the replies made mention of comparative U. S. and Soviet efforts in the field of arctic research. One thought that without the ARL the Arctic would have become largely the domain of the Russians and Canadians; while one saw the U. S. program at the ARL as a stimulant to the Russians, suggesting that it had stimu-

lated the U. S. S. R. to do more than it otherwise would have in zoology, botany, and other fields. One thought that because the Russians do this sort of thing we should too. One saw the ARL as a means of contact between the U. S. and the Soviets on a scientific basis. Varying degrees of modesty, or the lack thereof, were shown by three respondents. One was content to conclude that the ARL had lessened the gap between the U. S. and the U. S. S. R. in appreciation of arctic problems, while another thought that competitively we have far outdistanced the Russians. The third asserted flatly that the U. S. contribution to fundamental arctic research is unmatched. He claimed that we have taken the lead from Russia.

Some of the responses were favorable but brief. Those who thus concentrated their evaluation used terms such as "beneficial," "important," "considerable," "significant," "favorable," "very valuable," "facilitated research," "scientific cooperation," and "outstandingly important."

It was clear from the responses that, of those who recorded a view, the overwhelming opinion was that the ARL possessed considerable importance in the international sphere, and most were clear on why they thought so.

Strengths of the ARL

Of the 322 who returned questionnaires with meaningful information or comment, 199 made entries to that part of question eleven which asked for listings of the Strengths of the ARL. More than 280 items were listed.

Of the 199 who commented, 22 made favorable reference to the location of the Laboratory. Most of them did not give reasons. One mentioned the unique Alaskan base with access to the north slope and ice islands. One mentioned that the ARL was in a remote but interesting area; one mentioned the central location with several outlying field stations; and a fourth found it worth mentioning that the Laboratory is accessible to both land and sea.

Favorable comment on the facilities and logistic support provided by the ARL to the investigators was found in 78 responses. In 36 replies the term "logistic" was used in one form or another. Several used the expression "good logistic support", but more enthusiastic terminology was used by one who described the support as outstanding and by one who termed it tremendous.

In addition to the 36, there were 42 who made complimentary references to ARL support in a more general sense. Many of the compliments for the support function of the ARL were restrained and gave modest praise. Some were more outspoken in appreciation for extremely fine support given at a reasonable cost, or for being an excellent laboratory providing

a maximum of service to workers in a wide variety of fields. Another researcher praised all-out assistance to investigators as his principal judgment of the ARL's strong points. Among the many aspects of support that were singled out for praise were its "marvelous" communications systems, base camps, transportation facilities, equipment, cuisine, laboratory space, accommodations, machine shop, and more general "base of operations." Most of the responses, however, phrased their commendation in general terms, and some gave due allowance for the difficulties of providing full support under arctic conditions and limited facilities, especially in transportation of equipment. One respondent was particularly impressed by the great diversity of needs that confronted the ARL and the flexibility of the logistic design set up to meet these needs. One, harking back to a World War II slogan, credited the ARL with doing the difficult immediately and doing the impossible on many occasions.

In 33 of the "strength" listings the Director or "management" of the ARL was praised. All past Directors as well as the present Director received praise by name. Other favorable comments were impersonal. Sample statements indicated great appreciation of the Director's role. One covered the field by suggesting that the leadership (Hanna, Wiggins, Brewer) had been outstanding. Another called fabulous the support given by the Director and staff. One praised the excellent leadership by the scientific directors who in his judgment have worked far beyond the call of duty; another was impressed by the willingness of the Director

to accept the role of a service organization; one found some mighty fine administrators; another praised the able and imaginative leadership; another praised the good leadership in a harsh environment. Max Brewer was singled out for his role by a number as having a good understanding of the Arctic, as having done a "fine job," as having been "very helpful," as being a "good administrator," as being "both a scientist and an administrator," as being "a fine man to lead this team," and as a Director who is experienced in the Arctic and likes his work there. His assisting of researchers so they could get the most work done in a minimum of time was also appreciated. In addition to the comments which specifically referred to the Directors, there were comments about excellent administration, overall efficiency, and similar evaluations. It is, of course, to be assumed that favorable comments about the administration, ARL local services, and other broad observations reflected favorably on the Director, his Assistant, and his staff to some degree.

In many (26) of the responses the principal point mentioned was appreciation for the attitudes displayed by the ARL administration and staff. Several noted the "general spirit of cooperation" at the ARL and others mentioned the "desire to be of help" to the extent of going out of the way to help anyone doing research in the Arctic. Two respondents found it important that discrimination among projects was not practiced. One appreciated that the ARL gave support to the small investigator

who has no influence in scientific politics. Another asserted that investigators are welcomed regardless of the discipline or the area of support. Other responses found an ambitious "can-do" attitude, a real determination to get things done, and an eagerness to solve problems. Concern for the safety and comfort of the individual was appreciated, as well as friendliness and sympathetic attitude toward research. One stressed cooperation within the limits of safety and money. A sympathy for the investigator's problems and a desire to aid him, the congeniality of the staff, and willingness to make extraordinary efforts to assist research projects were also praised.

Another area of comment reflecting favorably on the administration and staff was found in 13 replies which listed among Strengths the ARL assembly of know-how and experience. Those factors were listed simply as "know-how" or "accumulated experience," or were more pointedly directed at "knowing how to help support a project" or "setting up complex experiments," or "helping new programs get started." That type of comment was perhaps best exemplified by one respondent who thought that the ARL's principal strength was that it is composed of men who know the Arctic and who live there. He also gave credit for accomplishments on a shoe-string of what others could not do at any price.

The staff was given pats on the back by direct comment in 25 of the responses. The remarks covered both competence and attitudes. The

staff was variously given credit for being "capable," "properly oriented," "competent," "helpful," "very competent and enthusiastic," "extremely cooperative," "extremely helpful in personal assistance," "a steady staff of people who know how to help and support a project," "always eager to solve problems," "skilled," "understanding of research and the climate," and offering "fabulous support." One respondent added his appreciation for some "mighty good" Eskimo assistants. Two others echoed that praise. One commended the ARL operation as truly a service to research, in the finest, most altruistic sense. That, he thought, had been accomplished with little clannishness and at great personal sacrifice by many of the permanent staff.

The aspect of ARL most frequently cited (60 times) as a Strength was its assembly of facilities, equipment, and supplies in one form or another. Most of the observations were stated in general terms, simply listing "facilities" or "equipment." Some added superlatives such as "surprising amount of sophisticated equipment," "excellent equipment," and "more than expected equipment." "Largess with supplies" was also noted.

The most frequently mentioned specific facilities were transportation, quarters, and food. Fourteen researchers commented favorably on the transportation, which was described as "excellent," "extremely useful," or "tremendously improved." Airplanes were specifically mentioned

by two, whereas another listed field transportation.

Fourteen respondents found it of sufficient importance to make favorable note of the food and accommodations. One went so far as to describe those facilities as "a fine hotel." One concluded that life was good at the ARL.

The outfitting and arctic clothing issued was noted approvingly by 3 persons, and one found "the available library" to be a strength. Laboratory facilities were appreciated especially by 4 researchers, and the machine shop was mentioned by 2.

One of the recurring themes of many responses was that it had promoted a diversity and a variety of arctic research. That theme was expressed in many ways, but at least 21 answers touched on the idea, some most forcefully.

Some of the comments were briefly stated, "varying of objects of study," "work in several specific fields," "breath of scope of research," "multi-discipline nature of the laboratory," "provides base for varied field research," the "diversity of research conducted," "interdisciplinary approaches to common problems," and "open to wide spectrum of investigators."

Among the points made were the references to the ARL's willingness to support all kinds of researchers doing all kinds of things; the philosophy of support for all areas of arctic research; the opportunity for people of

many disciplines to work on common scientific problems; and the interdisciplinary contacts which broaden the outlook of the participants. Also appreciated was the bringing together of scientists from many fields and universities in a congenial and productive atmosphere. One found the experience at the ARL stimulating because of the exchanges of ideas among representatives of different disciplines.

The value of that aspect of ARL was greatly appreciated by one who found the ARL to be the most stimulating institution with which he had ever been associated, more so than universities.

Half a dozen of the responses made specific mention of the ARL support of ice-island or drifting-station research. It was pointed out by one that the ARL would not have been as successful otherwise. Another mentioned the fine ARL support for research programs on ARLIS II and T-3. One respondent was favorably impressed by the flexibility in meeting new challenges, such as support of ice stations. Even more impressed was one who recorded his view that the possession of the one permanent ice-floe in the Arctic Ocean justified the ARL's existence.

Of the respondents 11 were impressed by the continuity and permanence of the Laboratory. That was stated briefly in most of the replies. One stressed the value of year-round operations with permanent staff and support, and one emphasized the importance of continuous research facilities for long-term projects. One considered the ARL the only real

and continuing contact with arctic research on U. S. soil. Another called attention to the fact that the ARL has been in operation for two decades for both seasonal and year-round studies. Some respondents avoided elaboration by proposing that the ARL's main strength is that it exists and is available.

The research program also drew a miscellany of other favorable comment. Among the points referred to were the fact that the ARL is not limited or directed toward military projects only; the high caliber of the research; freedom to work at one's own pace; the perfect environment for scientific investigation; the absence of restrictions on type of research done; support of basic research, which is ARL's greatest strength; the high research standards; the facilities provided for young scientists; and the ARL's support of research in the life sciences.

One found it a strength that the ARL was reasonably well funded, while another had been most strongly impressed by the "incredible cache of money" available to the ARL. One appreciated the relative freedom from mosquitos, while another was favorably impressed by the positive influence of the ARL on the Eskimos. One found it desirable that ARL provided an excellent lobby for arctic research, and another praised the Laboratory as providing liaison between government agencies, universities, and other groups. One praised the ARL's recognition and implementation of its own responsibilities, while another was impressed by the open, frank,

free, and organized fireside discussions. One found it good that the ARL had imposed some restraints on brash and thoughtless actions, while another praised the opportunity the ARL provided to one who desired to learn and advance.

Several comments were more pithy. Among them were references to lack of red tape, excellent organization, overall positive effects, all have benefited, indispensable, tremendous, reliability, integrity, and one insisted that he did not know of any strengths.

In summary, the favorable comments on ARL areas of strength covered a wide range of subject matter, with most numerous mention of the logistic support offered and the opportunities for arctic research.

Weaknesses

Of the 322 returned questionnaires, 177 had some comments about weaknesses of the ARL. Of the 177, 16 had no complaints and had such comments as "none that I can remember," "none, really," "can't think of any," "none that could have been avoided," etc. One felt impelled to discount weaknesses that would be found by intolerant investigators who themselves felt that the ARL had moved too slowly in satisfying every whim. He thought such persons should first look to their own weaknesses.

Of the remaining 161 who did find weaknesses, several had listings of two or three. The ones mentioned by the respondents can be grouped under a number of headings, which in turn fall under two major categories, namely those relating to the management of the ARL and those for which the ARL local management was not, directly at least, responsible. Among the latter were references to such matters as lack of funds, lack of equipment or facilities, shortage of administrative or scientific staff, location of the ARL, or comments on the contents of the research program.

Of the two types of comment more than half fell into the category not relating strictly to local ARL responsibility. Of the approximately 213 critical comments 99 related more or less directly to the local management of the ARL.

In addition to the two major categories mentioned, there were a few comments that did not readily fit. For example, one which presumably could be listed under "lack of facilities and equipment" or under "bad administration" was by one who complained of the insufficiency of popcorn on cold evenings, although he admitted that this might apply only to those who liked popcorn. One respondent was critical of the amount of paper work in applying for a grant, but explained that he had since learned to take that as a matter of course. One felt the weather was worth mentioning.

More seriously, one response, which had suggested that the ARL was essentially a "one man show," also found that the Laboratory was poorly integrated into the University of Alaska organization and did not take advantage of possible cooperation with other University of Alaska departments. Three thought that more briefing of researchers before their arrival at the ARL would be good.

Also of broader impact was the observation of one respondent that if the ARL were operated only by the University, instead of by military contract, it would attract more scientists, not only from the U. S. and Canada, but also from Eastern Europe, Russia, and other countries.

Another ventured the opinion that the ARL connection with the Navy was not the most desirable and that he would have preferred a purely scientific establishment.

Difficult to classify also was one investigator's conclusion that there had been an unfortunate belief that the operations of the ARL were such that it was actually too big to help small projects but that nevertheless it was too small to handle large major projects.

Despite the implied invitation offered by the question to air gripes and vent personal spleen, if any existed, there was little of that reflected in the answers. There were exceptions but not as many as might have been anticipated.

The most frequently listed weaknesses presumably not under the local ARL control were lack of equipment or facilities of adequate quantity or quality. In one form or another that was a principal point of 41 of the complaints. Particularly noted or complained of were shortages of transportation equipment, such as aircraft and ground vehicles, communications equipment, scientific equipment and materials, recreation facilities and laboratory facilities, as well as complaints regarding "Sears Roebuck quality field gear," boats, library, maintenance facilities, and "dreary living space." The emphasis given to transportation and communications equipment reflects the prime importance of such equipment to field research in the Arctic. One ventured the opinion that earlier communications problems had now been overcome.

Criticisms of the research program were noted by 25 respondents.

Of that type were critical observations on ill conceived and conducted investigations, too many undergraduates as researchers, support given mainly to larger projects, a tendency for principal investigator to visit the ARL only briefly or not at all, overemphasis on terrestrial vertebrates and earth sciences, the slighting of ecological research, arbitrary cut-off of all work on birds, the lack of applied research, the absence of a central program, poor selection of principal investigators, inability to attract outstanding men from outstanding universities, occasional duplication of research, scarcity of long-term environmental and biological studies, inability to guarantee long-term support, overcrowding of facilities, and the broader view that the scientific program was determined by what research proposals show up rather than by what should be done. The ARL program therefore had been disjointed, according to that view.

A shortage or lack of personnel at the ARL was noted by 16 respondents. Twelve of them clearly related to the permanent administrative and technical staff. Three noted the absence of a strong resident scientific staff and two mentioned lack of local scientific leadership.

Instead of the more specific complaints of shortages in personnel or facilities, 19 respondents blamed lack of sufficient financial support for the Laboratory. Criticized were "under-support," "shoestring

financing," or simply "lack of adequate funds."

Among the interesting criticisms offered were the observations of 7 respondents that the ARL is not well located at the northern extremity of Alaska; one mentioned the shortness of the period during which productive research could be carried on; another noted that the ARL was in an area of the Arctic where little U. S. and Canadian activity took place. One noted that if the ARL were a few miles farther inland, the fog would not hamper plane operations so often. The thoughtful observation was offered by one respondent that the ARL location had brought about perhaps too great a geographic concentration of research in the Barrow area. Another noted the need for an adjunct station in the Brooks Range.

Among those who commented on shortages of equipment, 2 made special mention of safety and survival equipment and especially of inadequate radios in aircraft. The need for a good library was mentioned by one investigator; another found that only a small start has been made toward a plant and animal museum.

Four of the responses raised the subject of publicity. Two stated simply that the ARL had not had enough of it; one found that not enough was known about it abroad or even in the U. S. A fourth comment suggested that an ARL journal be issued, which would publish research findings by ARL-sponsored investigators. Failing that, he suggested an annual volume containing abstracts of research papers.

Among the 99 weaknesses specifically laid at the door of the ARL local administration most were stated in non-personal terms. Criticism of the director, for example, referred in one case to the choice of directors who had been more interested in taxonomy. Another alleged lack of high-principled leadership, without further elaboration. A few comments were more personal, but only one could be characterized as abusive.

Most of the local weaknesses listed in the responses concerned administrative organization or procedures (38). Of them, 11 charged poor delegation of authority or no delegation of authority below the Director, signifying not enough decentralization of authority at the lower levels. One respondent found too much red tape; another thought the administration too cumbersome, with too rigid discipline; one found some hide-boundness in the ARL way of doing things. One charged that there was poor decision-making capability.

Two respondents found that there was a strong tendency to become over-extended, trying to support more projects than limited staff, planes and equipment properly could handle. One found lack of coordination between projects; one found an apparent inability to do advanced planning and organization in support of projects; one charged that even if procedures were outlined, one never knew when they should be followed; another found it had been impossible to set time schedules for receiving supplies

and equipment, even in times of good weather; one detected a need to learn how to maintain vehicles and equipment, while another contended that there was poor communication between the scientists and the administration. The ARL administration was thought by one person to have been slow in accumulating experience and by another was charged with failing to realize that work in the Arctic is different than in a temperate climate. One summed up his criticism in the judgment that the ARL gave a poorer than necessary performance as a service organization.

Several (25) respondents commented critically on the ARL permanent staff. The criticisms offered included charges of incompetency, procrastination, inefficiency, lack of interest, inside politicking, little awareness of the problems of working in the field, unreliable native help, a tendency toward infuriating principal investigators, and an inability to appreciate the very real hazards present considering the high percentage of inexperienced and unqualified personnel who were being sent to isolated stations. Some respondents simply indicated their view that the staff was not top class; that the staff was the ARL's greatest weakness, or that a good staff was needed. One recommended that the staff be put on a rotation basis. He contended that the Arctic is not a healthy place for permanent settlement. One critic did not specify clearly whether he was referring to the staff or the researchers when he commented with some delicacy that some at the ARL were "psychologically disturbed" and may

therefore have been the objects of some criticism.

Many of the adverse comments on the staff related more specifically to attitudes and motivations. Favoritism toward some investigators was charged in 2 responses, whereas another found that favoritism applied more specifically to "big name" university investigators. Similar, if broader, charges included alleged limited sensitivity to individuals, attitudes which caused unnecessary friction, too much attention to impressing VIP's, and not enough to run-of-the-mill investigators, as well as one assertion that sometimes one had to "play games" with those in authority in order to obtain necessary equipment. One respondent reported having heard that logistics are sometimes slowed down somewhat, simply to establish the point that the ARL rather than the working scientists was in control. Probably the harshest, if not the most precise, judgment on that subject was provided by the comment that the ARL needs to get some personnel who know what they are doing.

Most of the specific complaints of the respondents related to transportation and communications facilities and services at the ARL. Those aspects were mentioned in 23 replies.

Surprisingly, perhaps, the care and assignment of weasels came off rather lightly. One complained of too much "freeness" with the vehicles, leading to unnecessary losses, and another claimed simply that the weasels were mostly junk. Three researchers mentioned poor seagoing

facilities or inadequate boat facilities. Most of the criticisms concerned air travel, supply, and support. Several complained that field parties were sometimes left stranded because the pilot needed to be three places at once or because of delayed or overcommitted flights. Failure to supply field parties was mentioned by some. One softened his comment by mentioning "inevitable boo-boos." A few criticisms were more general, such as "disorganization in supply," "poor land transportation," etc. One carried more sting in its tail than in its head. It suggested that there was not enough transport to get away from the "blasted and polluted" vicinity of the ARCON camp.

Weaknesses in the communications system were mentioned by 9 respondents. It was asserted that radios in aircraft were generally inadequate, that there was inadequate radio equipment and not enough operators on drifting stations, and that communications facilities in the field could not be considered adequate. The area of concern repeated in half of the comments was the lack of adequate communications between the ARL and field parties. One respondent referred to the number of inexperienced, sometimes brash or naive individuals in the field operating under hazardous conditions. He thought that every field camp should have radio contact with the ARL. One critic, after claiming that radio-communication techniques and equipment were shockingly sub-standard, claimed that he had offered his services, gratis, to engineer a

proper system, but that his offer had not been accepted.

A few of the criticisms of the ARL management were more general. One thought the ARL was not familiar enough with problems originating outside the Arctic for the supported projects. Another critic, whose comment was even less specific, indicated that he would not depend on the ARL for support of a scientific project and that a reorganization was in order. Unfortunately, he did not elaborate on the present weaknesses nor on the nature of the desired reorganization.

One area which might have been expected to be a target for at least some complaint, was in fact not listed as a weakness in any of the responses. No one complained of the food, and only one was mildly critical of the housing at Point Barrow.

What the Questionnaire Revealed

The questionnaire showed clearly, and in some cases dramatically, the great impact of the ARL experience on the individual. In a great majority of cases that impact was stated in positive, favorable terms. In roughly nine out of ten cases that was the reaction. In most cases the scientific benefits were stressed, but many were obviously most intrigued by the arctic environment.

If the replies may be taken as a reliable indicator, more than half of those who had been at the ARL had their careers significantly affected by the experience. University teachers reported the value of their experience to their instruction; students gained advanced degrees; and many advanced professionally by the publication of their findings. One clear thread ran through the replies: The ARL experience stimulated a genuine interest in arctic field research; the existence of the ARL made it possible to carry that on and to return for further work. There were, of course, replies from others who indicated that arctic research had not become a career interest, or, if it had, they had not been in a position to pursue it.

For the great majority of researchers their ARL experience was their first exposure to research in an arctic environment. Their reaction, positive or negative, to this environment as a field for research provided answers of interest. The reaction was on the order of 3 positive to 1 negative, in regard to long-term interest. The evidence also indicated that

many who developed a taste for arctic research had been unable, for one reason or another, to continue or repeat their efforts there. A few appeared to have developed an interest to the extent of following the work done by others but not to the extent of wishing or trying to include such research in their own careers. The reasons given by those who developed no further interest either indicated that they did not like the arctic or had found the working conditions unsatisfactory.

The questionnaire and interviews brought forth a wide range of opinion and comment amounting to personal evaluations of the ARL, both overall and in detail. One respondent complained that the questionnaire was "too impersonal and mechanical to fairly elucidate what ARL was, is, and can be in the future." Even granting that characterization, it was all the more interesting to note how personal and non-mechanical many of the replies turned out to be. Many felt called upon to elucidate by letter, in addition to the direct answers to questions. In many cases the subjective reactions to mechanical questions were easily read, either on or between the lines. That was particularly true of the responses to the questions regarding the impact of the ARL and the queries on strengths and weaknesses.

The responses which evaluated the ARL's impact in the several suggested areas of possible influence have been analyzed in some detail. It was evident that many did not give much thought to that type of evaluation. Others felt they were not in a position to have worthwhile opinions.

Despite that, many interesting and provocative assessments were advanced. There were areas of disagreement, but on the whole that was less impressive than the consensus on a number of general conclusions.

It may be that those who knew most about the relation of the ARL to national defense were willing to say the least. One experienced project leader who had worked on projects of interest to the Navy came forward with the wry suggestion that, sadly, the ARL has had little impact on the Navy, other government agencies, or the national defense, although most of the research has been highly relevant to both tactical and strategic problems. One respondent argued that the ARL was not set up to provide arctic research in direct support of Navy operations and that the Arctic was not an area for routine operation of Navy ships. Hence one need not be surprised at the absence of strong positive evaluations in that direction.

The views on the impact of the ARL on the universities were much more vigorous, and more respondents were ready to offer comment. Aside from some understandable observations that the greatest impact had been on the individuals who participated rather than on the universities, and that only a few universities had participated to any great extent, nearly all comments were appreciative and many highly so. Understandably, a few earlier scientists became organizers and planners of additional research projects which came to involve many graduate students and other faculty members. Examples of such leaders were Pitelka, Mohr, Church, and Coachman.

A central theme of much of the comment was that the ARL had been a unique and an indispensable base for arctic scientific research. A note of restraint was introduced by a few who emphasized the relatively short period of ARL's existence and the "smallness" of the effort. Some were more impressed by the need and the potential for the future than by accomplishments during the early period.

The invitation to researchers and others to express their views on the strengths and weaknesses of the Laboratory produced much comment pro and con. Most found something to say on both counts, although many of the negative comments were offered in a sympathetic tone which indicated an understanding of the problems that had to be overcome.

The research program came in for both praise and criticism. On the positive side much emphasis was placed on the diversity and variety of research sponsored. Some stressed the interdisciplinary contacts as of great value. The bringing together of scientists from many fields was mentioned by several as a great plus for the Laboratory. The ONR philosophy of support for a broad program received much favorable comment.

Although the variety of comment offered in assessment of the ARL administration was such that no one view received unanimous support, the overall judgment was either directly positive or at least tolerant of observed weaknesses. It was not difficult in many cases to read between the lines that particular experiences or circumstances had produced very

personal responses. Nevertheless, there was a tendency to retain a sense of proportion and to stress the favorable side. Nearly all the personal comment about the Directors, for example, was either strongly praising or at least appreciative of their problems. The staff also received much commendation but also some criticism. It seemed to be the opinion of most that the reigns of management authority were rather tightly held by the Directors and that delegation of authority was sparing at most. That situation was viewed as necessary by many; as tolerable by others; and as a distinct weakness by still others. Several observers admitted the tendency toward centralization of authority, especially over use of transportation facilities, and justified it under the uncertain or dangerous natural conditions in combination with many young, or at least inexperienced, researchers who needed to be protected against themselves.

Of all the subjects discussed as strengths or weaknesses the one on which opinion seemed to be most sharply divided was the caliber, attitudes, and performance of the permanent staff. In about equal numbers of comments, the staff was considered "capable" on the one hand, and "incompetent" on the other; "enthusiastic" on the one hand and "lacking interest" on the other. Many found the staff to be cooperative, helpful, sympathetic, skillful, understanding, and eager to solve problems. Others found procrastination, inside politicking, a tendency to infuriate principal investigators, unreliability, and a variety of other adverse characteristics.

On the whole, the evaluation reflected the general sentiment that the facilities and equipment at the ARL were greatly appreciated and that deficiencies were mainly a result of a lack of funds and therefore were not the fault of the ARL administration and presumably not of ONR either. Some were less charitable than that, but they were a small minority. The more common estimate was similar to one who wrote that he had spent four days with the group at the ARL about three years earlier and had found it a great experience. He had been tremendously impressed by the breadth of capability of the facilities and by the services rendered. He concluded that the ARL was one case where every dollar being spent was more than worth it.

The evaluation of the ARL by those who were there also was indicated by comment written in letters that accompanied the returned questionnaires. One indicated that he had heard grumblings from some of the researchers about delays and restraints, but he had not found those complaints reasonable. He stressed the value and need of a team concept and had found that at the ARL. He thought it foolish to take chances in the Arctic and therefore he thought some guidance and control was necessary.

Another respondent who had been at the ARL both in its earlier days and more recently noted some reduction in the closeness of the community and a tendency for principal investigators to stay away. He found it to be a less stimulating place than earlier, but was inclined to attribute this as

an inevitable consequence of growth.

One writer summarized his view that the ARL had been invaluable to U. S. interests in the Arctic and that it had been plain good fortune that the Navy had been able to fund such a national institution.

SUMMARY AND ANALYSIS OF TWENTY YEARS OF RESEARCH

From a modest beginning of two research projects in 1947 the Arctic Research Laboratory expanded its research program during its first twenty years to an extent that was astounding to the early Scientific Directors Irving, MacGinitie and Wiggins. The major expansion has occurred during the second ten years. In 1956, for example, 19 research projects were operative at the ARL during some part of the year. In 1964 the number reached 78, and has not fallen below this number since.

The following table shows the pace of the expansion, year by year, in numbers of research projects actively pursued at or out of the ARL:

NUMBERS OF RESEARCH PROJECTS AT ARL EACH YEAR

	Physical Sciences			Biological Sciences			Social Sciences			Others			Totals		
	New	Repeaters	Total	New	Repeaters	Total	New	Repeaters	Total	New	Repeaters	Total	New	Repeaters	Total
1947	0	0	0	2	0	2	0	0	0	0	0	0	2	0	2
1948	3	0	3	7	2	9	1	0	1	0	0	0	11	2	13
1949	7	1	8	3	6	9	3	0	3	0	0	0	13	7	20
1950	3	5	8	5	5	10	0	2	2	0	0	0	8	12	20
1951	1	2	3	13	2	15	2	0	2	1	0	1	17	4	21
1952	1	1	2	5	10	15	2	1	3	0	1	1	8	13	21
1953	1	2	3	3	9	12	0	3	3	2	1	3	6	15	21
1954	5	3	8	2	5	7	2	0	2	4	0	4	13	8	21
1955	2	5	7	6	3	9	0	0	0	0	0	0	8	8	16
1956	6	6	12	2	5	7	0	0	0	0	0	0	8	11	19
1957	6	10	16	2	7	9	0	1	1	0	0	0	8	18	26
1958	9	9	18	7	5	12	3	0	3	0	0	0	19	14	33
1959	9	13	22	8	6	14	0	1	1	2	0	2	19	20	39
1960	32	12	44	7	7	14	3	1	4	0	0	0	42	20	62
1961	19	22	41	15	12	27	2	2	4	8	0	8	44	36	80
1962	17	20	37	5	11	16	5	2	7	0	1	1	27	34	61
1963	14	18	32	14	11	25	5	2	7	1	1	2	34	32	66
1964	21	25	46	8	15	23	3	4	7	1	1	2	33	45	78
1965	23	29	52	7	15	22	6	4	10	2	0	2	38	48	86
1966	12	26	38	19	13	32	1	5	6	3	0	3	35	44	79
Totals	191	209	400	140	149	289	38	28	66	24	5	29	393	391	784

The point should be made clear that the grand total of 784 projects is not the actual total of separate projects that were pursued during the 1947-1966 period. The total for the new projects column, or 393, is the significant indicator on that score. The number of repeaters is an interesting fact, but it does not increase the total number of separate projects that have been undertaken.

A word of caution is needed regarding the annual numbers of projects. In some cases one principal investigator, such as John Mohr or Philip Church for example, would have several listed "projects," even though the reason for the separate listings might be mainly in the locale in which the investigating was being done. Thus, for example, one project in micrometeorology might be pursued at Point Barrow and another on ARLIS II. They were counted as two projects. In other cases an investigation might be finished in two days and in some cases the weather or other circumstance prevented the researcher from achieving what he was after. These were counted as "projects," nevertheless.

The table records also the annual totals and hence the trends in the division between physical, biological, and social-science projects. The totals indicate, of course, that the physical and biological sciences have dominated the ARL research program from the outset. The table also shows that after twenty years the number of projects in the physical sciences had outstripped the biological-science projects by a hefty margin; 191 initiated projects for the former and 140 for the biologists. During the first

ten years the preponderance was reversed; 29 to 48. The physical versus the biological-science division may be shown in another way. During the first decade of the ARL, 1947 through 1956, the total of the annual biological-science projects outstripped the total of physical-science projects by 95 to 54, or by 64 percent to 36 percent. During the second decade, 1957 through 1966, the proportion was nearly reversed, 346 physical-science projects to 204 in the biological fields, or, in percentage terms, 63 to 37 in favor of the physical sciences. If only new projects are counted, the proportions remain about the same. The numerous physical-science projects operated from the drifting stations have partly accounted for the shift in emphasis, but the result has also been a consequence of deliberate choice by program planners. The social sciences, for rather obvious reasons, have placed a poor third, with only 38 projects initiated.

The following table lists 74 universities and colleges of North America which have been represented by principal investigators or research teams at the ARL. The table also indicates the number of such projects, by year, from each of the 74 institutions. The table is believed to be approximately accurate, but not absolutely so, because, in addition to possible error in compilation, there were a few cases in which the information did not indicate clearly whether a university or a government agency should be credited with the performance of a project.

NORTH AMERICAN UNIVERSITIES AND COLLEGES WHICH HAVE HAD PROJECTS AT ARL

Institution	Number of projects each year																				
	'47	'48	'49	'50	'51	'52	'53	'54	'55	'56	'57	'58	'59	'60	'61	'62	'63	'64	'65	'66	Total
Alaska, Univ. of			1																		69
Alberta, Univ. of																					2
Barnard College										1	1										2
British Columbia, Univ. of												1	1							1	3
Boston College			1																		1
Boston University																					1
California, Univ. of					1	1	1	1	2	3	2	2	2	3	2	2	3	3	2	1	2
California, (UCLA)																	1				30
Cal. Inst. of Tech.																					1
Carnegie Inst. of Tech.			2	1																	3
Cerritos College																				1	1
Columbia Univ.																		1			1
Catholic Univ. of America								1						1	3	2	3	2	2	1	14
Chicago, Univ. of																					1
Colorado A & M College							1							1	3	2	2	2	1		1
Colorado State																					2
Colorado School of Mines							1													1	1
Cornell Univ.	1	1	1																	1	3
Craigston Univ.		1																	1		4
Delaware, Univ. of																	1	1	1		2
Denver, Univ. of																			1		1
Duke Univ.													1			1					2
Fordham Univ.	1																				1
George Washington Univ.											1						1				2
Georgia, Univ. of									1												1
Harvard Univ.				1	1	1								2	1						6
Hawaii, Univ. of																		1			1
Idaho, Univ. of																		1	1		3
Illinois, Univ. of																	1		1		2
Indiana, Univ. of																		1			6
Iowa, Univ. of													1	2	1	1	1			1	4
Iowa State Univ.																					14
Johns Hopkins Univ.			1	2				1	1	1	1	1	1	1	2	2	1	2			5
Kansas, Univ. of																					2
Louisiana State Univ.					1	1													1		4

(continued)

Institution	Number of such projects each year																				Total
	'47	'48	'49	'50	'51	'52	'53	'54	'55	'56	'57	'58	'59	'60	'61	'62	'63	'64	'65	'66	
Mercator College															1					1	
Maryland, Univ. of																		1	1	2	
McGill Univ.														1				1	2	3	
Mass. Inst. of Tech.					2	1	1					1	1	1			1			3	
Michigan, Univ. of					1	1	1					1	1	1						6	
Michigan State Univ.												1	1	1						8	
Minnesota, Univ. of	1	1	1			1	1							1	1	2	2	1	1	13	
Missouri, Univ. of					1	1	1										1		1	3	
Montana State College									1										1	3	
Nebraska, Univ. of												1								1	
New Mexico, Univ. of																		1	1	2	
North Carolina State Univ.																			1	1	
Northwestern Univ.					1	1	1	1												4	
Ohio State Univ.														1	2	2	1			6	
Oklahoma, Univ. of												1								2	
Oregon State Univ.															1				1	2	
Penn. State Univ.									1											1	
Pittsburgh, Univ. of														1						1	
Princeton Univ.													1							1	
Purdue Univ.																				2	
Rutgers Univ.									1	1										9	
San Diego State														1	1	1				3	
Santa Barbara College															1	1	1			1	
San Francisco State College																				1	
St. Louis Univ.			1	1											1					1	
Saskatchewan, Univ. of																				2	
Smith College													1						1	1	
Southern California, Univ. of					1	2	2	1						1	2	6	1	2	3	2	
Stanford Univ.			1	1	2	3	4	2	4				1	1	1	1			2	25	
Swarthmore College			1	3	2	1														22	
Syracuse Univ.														1	1	1	1			7	
Tennessee, Univ. of																				4	
Texas, Univ. of									1	1	1	1								4	
Tufts Univ.																1				1	
Washington, Univ. of														1	1			1		3	
Washington State Univ.					1	1							1	2	7	5	3	5	5	9	
Washington Univ. of St. Louis																				46	
Wisconsin, Univ. of																			1	1	
Yale Univ.						1	2		1	1	1	1	1	2	1	2	1	1	1	22	
Totals	2	10	9	8	14	19	14	12	13	12	11	18	19	33	46	33	41	45	28	46	433

The institutions listed are scattered from east to west and from north to south. The western and Alaska institutions are more heavily represented, but the geographic pattern is not a concentrated one. The number of Swarthmore and Stanford-led projects during the early years of the ARL was related to the fact that Dr. Wiggins was a Stanford professor and that Swarthmore held the operating contract with ONR for the first period of years and Dr. Irving was then a professor there. The later years also have shown tendencies among certain universities to remain represented by several projects. The universities of Alaska and of Washington are in that limelight. Four Canadian universities are in the list.

The normal year during the last ten years had had research teams from between 20 and 30 universities and colleges. That indicates that the representation has not narrowed, even though the two named universities have had large numbers of separate projects. In order to indicate which of the 74 represented institutions have predominated, the following compilation has been made:

INSTITUTIONS WITH LARGEST CUMULATIVE NUMBERS OF PROJECTS

1.	University of Alaska	69
2.	University of Washington	46
3.	University of California	30
4.	University of Southern California	25
5.	University of Wisconsin	22
6.	Stanford University	22
7.	Yale University	15
8.	Columbia University	14
9.	Iowa State University	14
10.	University of Minnesota	13
	Total for highest 10	270
	Total of all university projects	433
	Percent of total of top ten	62%

The geographic spread of institutions that have been represented by projects at the ARL is indicated by the fact that the 70 U. S. institutions are scattered among 32 States plus the District of Columbia. Represented by most institutions has been California, with nine; Massachusetts, with six; New York, with five; and Pennsylvania and Colorado, with four each.

In addition to North American colleges and universities that have used the ARL for one or more projects a number of other institutions of various types, including several outside North America, have been represented. Thus four Japanese universities (Hokkaido, Meiji, Tohoku and Tokyo) have participated; as well as two Danish, two English, one Swedish, one German, one Irish, and one Brazilian educational institution. Those 12 institutions have had a cumulative total of 18 projects at the ARL.

In addition to the colleges and universities included in the list, there also have been a number of other institutions, some with university affiliations, that have had research projects at the ARL. Included are the Riksmuseum, Stockholm; the National Museum of Canada; the National Science Museum of Japan; the New York Botanical Garden; the Smithsonian Institution; the Laboratory of Climatology; the California Academy of Sciences; the American Foundation of Biological Research; the Graduate Research Center of the Southwest; Preston Laboratories; Geologische Forschungstelle, Germany; Woods Hole Oceanographic Institution; Scripps Institution of Oceanography (University of California); and others.

Because the ARL was established by the ONR and has remained under its auspices, government agencies have been encouraged to use the facilities provided by the Navy. The distinction between government-research projects and non-government projects has not been clear cut, because not only ONR but also other agencies have financed research projects which were carried out by non-government institutions. The ONR-AINA-university-type project is an example. That is simply another way of saying that government has paid for much of the research done by others. In the first decade of the ARL 65 percent were by universities; in the second decade only 52.5 percent were university projects.

Aside from such farmed-out research and independent non-government research there has been a heavy representation of government agencies, federal, state and even foreign, among the projects that have been carried on. Among the sponsoring agencies were:

Defense-Related Agencies

Navy - Office of Naval Research
 Naval Electronics Laboratory
 Naval Civil Engineering Laboratory
 Naval Ordnance Laboratory
 Naval Underwater Sound Laboratory
 Bureau of Yards and Docks
 Naval Oceanographic Office (before 1962, The Hydrographic
 Office)
 Mine Defense Laboratory
 Naval Air Development Unit
 Naval Communications Station, Kodiak
 Fleet Weather Central
 U. S. N. Port of Seattle

Army - Corps of Engineers
Army Materiel Command, Cold Regions Research and
Engineering Laboratory
Walter Reed Army Medical Center

Air Force - Air Force Cambridge Research Center
Arctic Aeromedical Laboratory

Other Agencies

Interior Department
Geological Survey
Fish and Wildlife Service

Department of Agriculture

Department of Commerce
Environmental Science Services Administration
Coast and Geodetic Survey
Weather Bureau
National Bureau of Standards

Department of Health, Education and Welfare
Public Health Service
Arctic Health Research Laboratory
National Institutes of Health
National Institutes of Mental Health
Bureau of State Services

Atomic Energy Commission
Battelle Memorial Institute (Contractor)

National Aeronautics and Space Administration

National Science Foundation

Alaska Department of Fish and Game

Alaska Agricultural Experiment Station

Netherlands Geological Survey

The universities, American and non-American, accounted for about 57.5 percent of the 784 cumulative total of projects at the ARL. The remaining 42.5 percent were performed by government agencies and, a far smaller number, by miscellaneous institutions.

No accurate count is available of the number of individuals who have played a significant part in the research teams that have been connected with ARL support. Approximately 1100 names were collected, but the list was doubtless missing many names that might have been included. An estimate found in 1959 ONR records claimed about 400 up to that date. The annual numbers since then have been at or above 200, but of course many of those have been repeaters. A total figure of 1500 individuals would probably not be far off the mark.

PUBLICATIONS

The measurement in any meaningful terms of research accomplishment is most difficult. Probably it would be agreed generally that an appraisal of the record of publication resulting from research is one way of obtaining some sort of an indication of the accomplishment of the research. This has been attempted in the case of the ARL with interesting results. However, the results are felt to be indicative only. The principal basis for the appraisal was the completed questionnaires returned by the researchers. Some additions were made by using the Arctic Bibliography. In general, the publication record seems to be good. It appears further that publications on research in the biological sciences reached a high point in 1952 through 1955; in the social sciences in 1962 and 1963; and in the physical sciences in 1964 and 1966.

Of the questionnaires sent out, only 322 were returned and, of those, 10 had to be disregarded as an indication of publications because they were incomplete, conflicting, or otherwise unusable. Thus the appraisal is based on less than one third of the total number of researchers up to the date of the mailing of the questionnaires. Also omitted, of course, are the publications appearing after the mailing of the questionnaires up to the present time.

Two or three books such, for example, as that by Wiggins and Thomas on A Flora of the Alaskan Arctic Slope, seem to have come from work done largely or entirely at the ARL. Several others appear to contain the results of such work in different degrees along with other work. An example is Hultén's Flora of Alaska and Neighboring Countries.

The 312 usable questionnaires were divided into those reporting on the biological sciences, the physical sciences, the social sciences, and on technical and other work.

The last category, technical and other, is the smallest group. Thirteen researchers reported the production of four films and a few technical papers and semi-popular articles without supplying enough data to be very useful in making an appraisal. Of the remaining 299 usable questionnaires, 135 reported on biological research, 146 on research in the physical sciences, and 18 on research in the social sciences.

The reader is reminded that the questionnaires went to all researchers who could be reached by the procedure used and not just to project leaders. Furthermore, articles by joint authors were counted only once, under the senior author. Abstracts were not included in making this analysis.

In regard to the biological articles, the 135 investigators reported 2,79 articles in technical journals, in other research and technical reports, and as contributions to symposia. Those articles contained a total of 3,862 pages or an average of 12.9 pages per article. In addition, the investigators reported 40 articles but failed to indicate their lengths. If they averaged the same as the articles for which lengths were given, 516 more pages could be added to the record.

Corresponding data for the physical sciences are:

Number of investigators	146
Number of articles reported	178
Number of pages reported	2,417
Average number of pages per article	13.6
Additional articles reported (number of pages not given)	89
Additional pages, assuming articles of average length	1,210.

The record for the social sciences on the same basis is:

Number of investigators	18
Number of articles reported	57
Number of pages reported	781
Average number of pages per article	13.7
Additional articles reported (number of pages not given)	3
Additional pages, assuming articles of average length	41.

In all, the 135 researchers in the biological sciences reported 339 articles or 2.51 articles per researcher. The corresponding record for the physical scientists is 1.83 articles per investigator; and for the social scientists 3.33 articles.

Most of the above data are summarized below:

	Number of researchers	Number of articles	Number of articles per researcher	Number of pages (adjusted)	Average number of pages per article	Average number of pages per researcher
Biological sciences	135	339	2.51	4,375	12.9	32.4
Physical sciences	146	267	1.83	3,627	13.6	24.8
Social sciences	18	60	3.33	822	13.7	45.7
	299	666	2.23	8,824	13.2	29.5

With the assistance of the Editor of the Arctic Bibliography, the authors selected in the biological, the physical, and the social sciences a group of professional journals judged to be the major and most respected journals in those segments or divisions of research. In order to test, at least in a general way, the quality of the papers originating in research at the ARL, we then reviewed how many of the articles reported had appeared in those selected journals. The results were 19 percent in the biological and physical sciences, and 22 percent in the social sciences. For obvious reasons the selected journals are not identified here.

THE DIRECTORS' STORY

All Directors past and present, except one, were interviewed. It was apparent that the roles played by each differed considerably, determined in part by the individual himself and in part by the stage of ARL development at the time each was Scientific Director or Director.

For example, Dr. Irving and Dr. Wiggins were recognized scientists in their fields, as was Dr. MacGinitie. Their titles, as well as their roles, indicated that they were "Scientific Directors." As such they, and Dr. Wiggins in particular, were expected to spend much time and effort in recruiting scientists to come to Point Barrow on research projects, frequently suggested in fact by the Scientific Director. That meant correspondence and travel, primarily involving a few universities, much of it during the winter months when the ARL was in its doldrums. During the height of the ARL research season (June-September) the Scientific Director was, perforce, so busy with the thousand and one administrative duties at Point Barrow that the "scientific" aspect of his function had to take a back seat.

Although Dr. Wiggins returned to the ARL for a few months in 1956 for his second tour as Scientific Director, the role of the office already had changed under Ted Mathews and Dr. Hanna. They both had found that their function was almost entirely administrative. ONR in Washington was well aware of what was happening and began to look around for a permanent "Director" who would not be a short-termmer and who would function mainly as an administrator. Indicative of that fact was both the choice and the title

of Max Brewer, who became "Director" of the ARL in the fall of 1956. Since then there has been occasional discussion in Washington and at Point Barrow of the possible advantages of having a "scientific assistant director" at the ARL, but this has not been accomplished. As had been noted, Dr. Wiggins felt that there should be a scientific as well as an administrative head at Point Barrow. Some investigators have echoed that view, arguing that the meshing of several research projects at the ARL would be accomplished more smoothly and productively if there were a top scientist of understanding and authority on the ground at the Laboratory. In part, senior project directors, such as Dr. Frank Pitelka, have tried to fill that need.

All the Directors interviewed were well aware that whatever their function as scientists, they were constantly being required to make critical administrative decisions and that, like the captain of a ship at sea, they were personally responsible if anything went wrong.

All Directors, as masters of their craft, were able to observe very closely the personalities of the resident researchers. The researchers, in turn, were intimately affected by the personalities and methods of the Directors. Because personal relations of the type experienced at the ARL often produce problems for which there are no rule-book answers, one is not surprised to find the subject of inter-personal relations a matter of great interest, both to the Director and to the other

personnel at the Laboratory. In fact, Dr. William Smith, from Walter Reed Institute of Research spent many months at the ARL observing these, among other phenomena, as a research project in itself.

The Directors' evaluations of the resident investigators have naturally varied from one Director to the next. The early Directors especially, being first and foremost professional scientists and only incidentally amateur ship captains (executives), had a great sympathy and a close understanding of the resident researcher who usually had a similar scientific-academic background. As the Laboratory expanded in numbers, as well as in complexity, and geographic scope of operations, that situation changed, and not necessarily because of a change in the personal background of the Director. It was perhaps inevitable under the circumstances that the one-happy-family situation became more institutionalized, and the visiting scientific investigator was expected to take his proper place in accordance with established rules and procedures.

As was to be expected, all the Directors interviewed were ready to say that the researchers had included many able, serious, and dedicated persons. On the other hand, they also were ready to affirm that some had been boon dogglers and that a fair number had possessed difficult, self-centered, and abrasive personalities, or were troublemakers. By and large the respect of the Directors for the scientific investigator in the Arctic was high. Only one comment was heard about researchers "running around with their butterfly nets." Mention was also made of some "gold brickers enjoying an interesting vacation." One of the former directors commented on the composition

of the researcher group and found it natural that most of them were younger graduate students working under non-resident senior project leaders. In fact, he found that that tended to spread the interest in arctic research and to shape the careers of many to the great advantage of all concerned.

Mention was made by some Directors of the constant problems they had contended with, in particular the allocation and scheduling of air and ground transportation. Sometimes related to those problems was the constant need to keep in mind the first requisite — namely, the elimination of unnecessary risks to the safety of the field researchers. The Directors were well aware that the exercise of authority in those two areas was a likely breeder of discontent and criticism. There was criticism on these scores from a few, but not from very many. Naturally each field researcher was most concerned about his own progress. Delays and even necessary frustrations easily produced friction. Several investigators, realizing the problem of the Director, were careful to assess no personal blame for the frustrations. Nevertheless, it was clear that the Directors in lesser or greater degree felt the burden of protecting inexperienced or brash researchers from their own carelessness or ignorance of risks in the Arctic.

One of the functions which circumstances forced upon the Directors was the peacemaking or refereeing role as between scientific projects and personnel. Since the researchers were not responsible to the Director for the content of their research project, nor for the results obtained, there was not the same foundation for the exercise of mediation or control functions as would be found in a more typical hierarchical organization. Reasoning, persuasion, and, in

the last analysis, control of ARL facilities and equipment were methods that were used. At the same time, of course, the Director had to be aware constantly of the source of his own authority. Technically an employee of the administering institution (Swarthmore, The Johns Hopkins University, or the University of Alaska), the Director at all times was dependent for counsel, advice, and ultimate control upon the Navy (ONR). Those representing ONR supplied powerful support at all times. That was much appreciated by all Directors.

Because during most of the ARL's history, it has been dependent on an outside contractor for such necessities as food, housing, building maintenance, fuel, heat, light, and other services, one function of the Director has been to work closely with the contractor officials to secure the services needed at acceptable standards. In total, the relationships appear to have worked out very well. The Arctic Contractors of Pet 4 days, Puget Sound and Drake, and later the Vinnel Corporation all have cooperated and functioned to the general satisfaction of the ARL Directors. Many compliments were given to the contractors for their excellent attitudes and performances.

Although the Directors have not been personally responsible for determining the scope and content of the total research program, some of them expressed their views on that fundamental aspect of the ARL. One thought the mix and balance of the program had been good. He had noted a trend toward the earth sciences, including oceanography, meteorology, magnetism, glaciology, and geology, but he thought that had been a natural development.

One former Scientific Director thought there would have been advantages to more centralized program planning in ONR hands. He had found the program to be somewhat hit-or-miss. He thought, nevertheless, that there had been advantages in using the Arctic Institute, for example, in program planning, because that had permitted more basic research than would otherwise have been possible. However, he thought that coordination of projects could have been better. He mentioned, as an example, the slow realization among the program planners of the fact that research, even in zoology, could and should go on in the winter too. For university people it of course was understandable that the summer months permitted productive arctic field research without interference with the normal academic year.

In recent years there was a tendency for the Director of the ARL to become more involved in the preliminary planning and advance preparation for ARL support to research projects. For example, researchers in zoology formerly would have used much of their time in the Arctic in catching their own animals for study. The Laboratory collected its own "zoo" which was placed under the care of Pete Sovalik, one of the Eskimo veterans on the ARL staff. The "zoo" was located to the rear of the main ARL offices, thus serving to alleviate somewhat the usual arctic quietness. In March 1967 the animal collection included two polar bears, two grizzlies, wolves, foxes and a lynx, plus some smaller animals.

Discussions with Dr. Brewer revealed clearly that the role of the Director has been greatly affected by the increasing scope and sophistication of

arctic research, by conscious efforts to improve the functioning of the Laboratory and its services to the investigators, and by the greatly increased emphasis on ice-island activity.

The increased scope and complexity of the research program have resulted in logistic demands which would have been beyond the realm of possible execution in the forties and early fifties. Field camps were then mainly tents set up by each research party and the shelters were dismantled and removed when the local investigation had been completed. An early camp set up by Pet 4 at Umiat was partly opened to ARL use, but that was an exception. In order to permit investigators to concentrate on their research, instead of having to spend much time on setting up housekeeping, a large number of field substations with semi-permanent, movable, wooden structures have been set up. By 1967 there were 21 such camps north of the Brooks Range, extending from southwest of Barrow east to the Canadian border. Eight of them were former DEW Line camps taken over by the Navy from the Air Force. In addition to the sub-camps on land there also was the "permanent" camp on T-3. The structures at the sub-camps were mostly of the wanigan type—small, movable, wood structures built at the ARL by its own carpenters, then transported to the site, perhaps flown in sections. The wanigans are well insulated and fitted with heating and cooking equipment. Bedding is left in some; in others the researchers take along both bedding and food. The Director thus has been running a construction operation as well as an outfitting and supply service. One of the largest building projects undertaken by the ARL was the construction for NASA of the Point Barrow

building from which upper atmosphere weather rockets are launched. Director Brewer estimated that ARL construction saved the Navy more than the amount it cost the ARL to build it.

The increasing importance of ice-island research in recent years also has placed greatly increased demands and responsibilities on the ARL, but particularly on the Director. Because the ice-island stations usually were hundreds of miles distant from the ARL (or even thousands of miles during the last stages of ARLIS II), the problems of supply and transportation of personnel have been greatly multiplied, and again the Director has borne the brunt of responsibility. Because equipment, supplies and personnel normally can only be flown to the ice-island camp, there has been a great emphasis on transport of great tonnage during the seasons when that is possible. February, March, and April are usually the best months. Dr. Brewer indicated, for example, that in 1955-56 the total annual flying hours for the ARL had been in the neighborhood of 100. In 1966 ARL aircraft alone flew 2600 hours. In addition ARL used charter flights, Air National Guard flights, and others. Thus, in addition to his other duties, the Director runs an air-freight and air-passenger service with an air fleet that included much ancient equipment. That has required faith, ingenuity, know-how and just plain guts on his part and on the part of the pilots who have flown the aircraft. The wings of the R4D's may have been strengthened, and extra fuel tanks may have been installed, but it can only be counted as a great combination of human accomplishment and divine luck that more serious accidents have not occurred.